WattMaster WHP

Control Systems

WHP - Water Source Heat Pump Design, Installation & Operations Manual

Revision 02A

WattMaster WHP

Installation & Operations Manual

Section 1..... Design Guide

Section 2.....Installation and Wiring

Section 3.....Programming

Section 4..... Start-Up and Troubleshooting

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WattMaster
CONTROLS

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Conventions

This document uses the following definitions throughout as a guide to the user in determining the nature of the information presented:

Note: Additional information which may be helpful.

Tip: Suggestion to make installation, set-up, and troubleshooting easier.

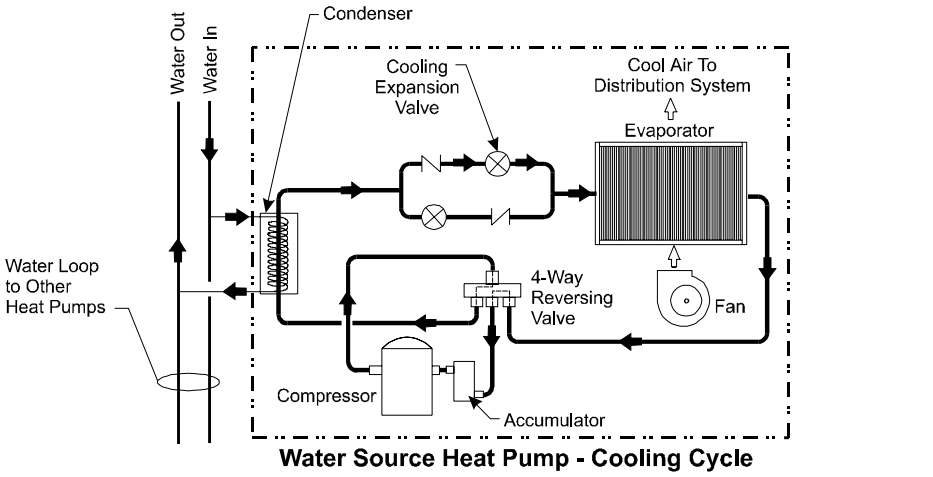
Caution: Items which may cause the equipment not to function correctly but will not otherwise damage components.

Warning: Errors which can result in damage to equipment and void warranties.

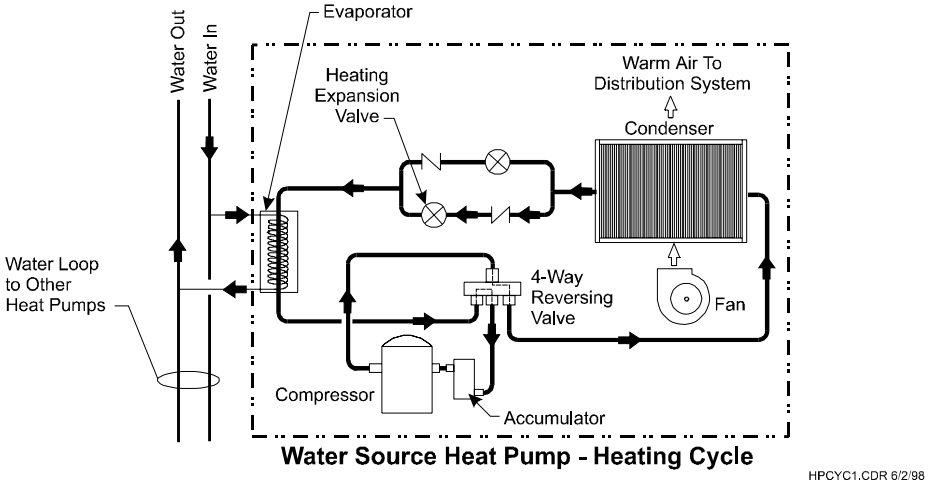
General Information

Water Source Heat Pump Units

A water source heat pump is a self-contained water-cooled packaged heating and cooling unit with a reversible refrigerant cycle. Its components are typically enclosed in a common casing, and include a tube-in-tube heat exchanger, a heating/cooling coil, a compressor, a fan, a reversing valve and controls.



Water Source Heat Pump - Cooling Cycle



Water Source Heat Pump - Heating Cycle

HPCYC1.CDR 6/2/98

Figure 1-1: Typical Water Source Heat Pump

During the cooling mode, the tube-in-tube heat exchanger functions as a condenser and the coil as an evaporator. In heating mode, the tube-in-tube heat exchanger functions as an evaporator and the coil as a condenser. A reversing valve is installed in the refrigerant circuit permitting changeover from heating to cooling, and vice versa. The condenser and evaporator tubes are designed to accept hot and cold refrigerant liquid or gas.

Water Source Heat Pump Systems

The water source heat pump system is, by definition, a heat recovery system. It is best applied to buildings that have simultaneous cooling and heating loads. This is the case during winter months when the interior zones of a typical building require cooling while the exterior zones require heating. When a water source heat pump system is used, the heat rejected by the cooling units is used to warm the zones calling for heat. A water heater is generally used for adding heat to the condensing water during peak heating periods, if necessary. The system also utilizes a water cooling tower to reject the heat energy from the condenser water loop during periods of high cooling demand.

Water source heat pump units can be suspended in the ceiling plenum, floor mounted behind walls or placed directly in the occupied space as a console unit. There are also rooftop and unit ventilator type water source heat pumps.

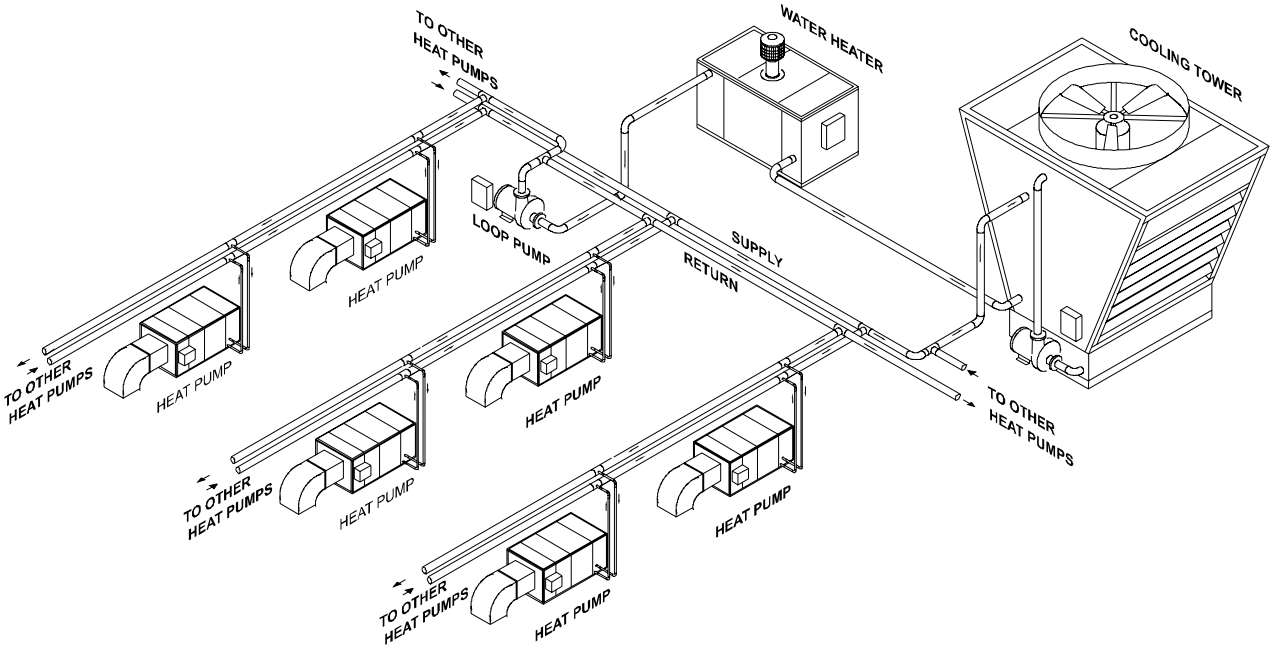


Figure 1-2: Typical Water Source Heat Pump System

Water source heat pump systems generally cost less to install than central built-up systems. They offer individual zone control with the added flexibility of being able to

accommodate changes in location and sizes as thermal zones or zone occupancy change. This system is often installed in ceiling plenums, which frees up valuable floor space.

Another valuable benefit of water source heat pumps is that they can accommodate simultaneous calls from zones requiring heating or cooling. Depending on the climate, outside air may require preheat or cooling prior to being introduced to the unit. In the example of ceiling mounted water source heat pumps, put outside air ducts near each unit to improve indoor air quality.

Normally, multiple units serve an occupied space. This gives component redundancy to the system so if one unit were to fail, the other units could back it up until the unit was repaired. The packaged design of most unit types allows quick change-out by service personnel so maintenance can typically be performed off site.

As with any HVAC system, there is a negative side as the water source heat pump system often requires higher maintenance costs than conventional air side systems. The system also typically has a shorter replacement life than other systems because of continuous fan and compressor operation during heating and cooling modes. The system can also create room noise since the compressor and fan are commonly located close to the zone occupant. Placing units away from the occupied space and ducting the supply air to the zone can minimize potential noise problems.

WattMaster WHP Control System

The **WattMaster WHP** system is used to control the water loop and the individual water source heat pumps installed in a typical water source heat pump system. The WHP system is an excellent alternative over programmable thermostats. The WHP control system provides one central location to monitor and program all the water source heat pumps on the system instead of having to program each water source heat pumps thermostat individually. The system has many features typically not found with programmable thermostats such as: central operators interface, heating/cooling failure alarm, auxiliary alarm, and holiday scheduling, to name but a few.

WHP Controller

The Water Source Heat Pump Controller (WHP) is used for controlling individual water source heat pump units. The WHP Controller can operate stand-alone or it can be used with the Water Source Heat Pump Loop Controller and in this configuration shares common data, such as outside air temperature, proof of flow etc., over a network. A System Manager is connected to the WHP Controller to provide a central operators interface to all WHP Controllers on the network. WHP Controllers are designed with Room Temperature, Room Setpoint Adjust, Discharge Air Temperature, Leaving Water Temp or Dirty Filter Alarm and Auxiliary Lockout inputs. Relay outputs provided are; Fan (Continuous or Cycling), Reversing Valve-ON/OFF, Compressor-ON/OFF, Heat

Pump Reset and Aux. Heating or Cooling. An internal seven day schedule and holiday schedule functions are also built into each WHP Controller.

With the WHP system the sometimes complex control requirements of a large water source heat pump system can be handled with an off the shelf controls system that has most of the features of a full blown building automation system but at a much lower cost. Included with the WHP system is a communications interface module, which allows you to connect a computer to the system onsite and a modem connection for remote monitoring.

Prism, a Windows based software package is available at no additional charge. Some of Prism's features include graphics, trend logging, and remote alarm call out capabilities.
WHP Loop Controller
The Water Source Heat pump Loop Controller can be supplied with the system to control the water loop and its various pieces of equipment. The Loop Controller can operate stand-alone or used with the Water Source Heat Pump Controller (WHP) and in this configuration communicates common data, such as outside air temperature, proof of flow etc., over a network. A System Manager is connected to the Loop Controller to provide a central operator's interface to the Loop Controller's setpoints and operating configurations. The Loop Controller is designed with inputs for Supply and Return Water Temperature, Outdoor Air Temperature, Loop Water Pressure Switch or 0-50 PSI Loop Pressure Sensor (4-20ma), Manual Reset Contact, Phase Loss Contact, Request to Run Relay, and Fire/Smoke Relay. Analog outputs (0-10VDC) are supplied for Pump VFD and Proportional Heat. Binary outputs are provided for Compressor Enable, Main Pump Relay, Standby Pump Relay, Alarm Contacts and (8) Relays that can be configured for Heat Rejection or Heat Addition.

Make Up Air Controller

A Make Up Air Controller, for treating 100% outdoor air, is available for use with the Water Source Heat Pump system. Please consult factory for more information on this product.

WHP Sequence of Operation

HVAC Mode of Operation

There are four possible modes of operation. These are Cooling Mode, Heating Mode, Vent Mode, and the Off Mode. The HVAC mode of operation is calculated the same way in both occupied and unoccupied modes of operation.

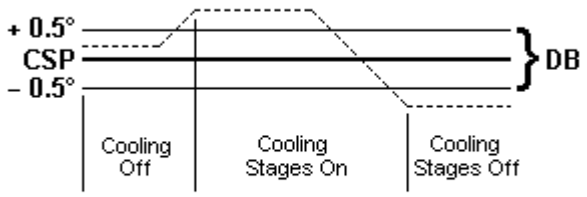
Off Mode The schedule is off and no overrides are active. There is no heating or cooling demand in the space. Under these conditions, all outputs will be off and the analog output will be set to 0.0 vdc.

Vent Mode No heating or cooling demand exists during the occupied mode of operation. The fan will be on if the WHP is programmed for Constant Fan operation. The compressor demand request will not be sent to the Loop Controller. If no WHP units are sending a request, the Loop Controller will discontinue operation after 15 minutes.

Cool Mode A cooling demand is generated when the space temperature rises half the amount of the Deadband Setpoint above the currently active Cooling Setpoint. The space is considered satisfied when it drops that amount below the Cooling Setpoint.

Heat Mode A heating demand is generated when the space temperature drops half the amount of the Deadband Setpoint below the currently active Heating Setpoint. The space is considered satisfied when it rises that amount above the Heating Setpoint.

Occupied Cooling Mode Example



The Cooling Staged On @ 74.5°F and Staged Off @ 73.5°F

Cooling Setpoint (CSP) = 74°F
Deadband Setpoint (DB) = 1°F

Occupied/Unoccupied Mode of Operation

Since the WHP contains its own built in Real Time Clock, it can operate from its own internal scheduling system. This schedule supports two Start & Stop events per day and up to 14 Holiday periods. The Holidays all use the same special Holiday Start/Stop times programmed by the user.

If the current operating mode is unoccupied, the WHP can accept a push-button override back to the occupied mode. Push-button overrides are not recognized if the current mode is already occupied. The push-button override duration is user programmed. If the user wants to extend the current override without reprogramming the Duration, they can re-initialize the existing programmed period by pressing the override button anytime during the current override. If the current override had been active for 1 hour and 45 minutes and the user presses the push-button again, the override will reset for another 2 hour period (*if they programmed a 2 hour period*), bringing the total override time to 3 hours and 45 minutes. If the user wants to cancel an override before it can time-out, simply hold the push-button for a period of time between 3 and 10 seconds.

The WHP calculates its current heating and cooling setpoints based on the current mode of operation. If the command is for unoccupied mode, the WHP adds the unoccupied setbacks to the occupied heating and cooling setpoints.

Vent Mode Operation

During occupied hours when there is no heating or cooling demand, the WHP reverts to a **Vent Mode** of operation. The fan is running and the heating and cooling outputs are held off.

See the section titled **HVAC Mode of Operation** for a graphical description of how the **Vent Mode** is calculated.

Off Mode of Operation

After the schedule goes unoccupied and both heating and cooling demands go away, the fan stops running, all relay outputs are turned off. No outputs are allowed to activate in the **Off Mode** until a heating or cooling demand occurs. During occupied hours this would be the **Vent Mode.**

HVAC Operation w/ Reversing Relay

If the user has configured the WHP to control a Reversing Valve and a Compressor, the following sequence of operation occurs during a heating or cooling demand.

Note: If you configure the WHP to look for a proof of flow Enable signal from the Loop Controller then the following sequence assumes a request was made by the WHP during a demand condition and that the Loop Controller gave permission for the WHP to start its compressor. Otherwise, the WHP will ignore the Enable signal and operate anytime there is a heating or cooling demand.

---

a. If the last mode was the opposite of the current demand mode, make sure the Changeover Delay has been satisfied.

b. If the unit is configured to control an Isolation Valve, the valve relay is activated (Relay #5). The Minimum Off Timer is reset to ZERO and must be satisfied before any further operations are allowed.

c. If the current mode requires the Reversing Valve to be activated, its relay contact is closed and a 10 second delay is started.

d. Ten seconds after the Reversing Valve is activated, the Compressor relay is activated.

e. If the Space Temperature continues to exceed the affected setpoint by the full amount of Deadband and you have configured for 2 stages in the current mode of operation, relay #5 will activate for the second stage of heating and/or cooling. A second stage of either implies that no Isolation Valve exists!

f. Once the Space Temperature has crossed back over the affected setpoint, stage 2 will be turned off if the unit has a stage 2.

g. As the Space Temperature continues to cross back over the affected setpoint by half the Deadband value, the compressor will then be allowed to turn off if the Minimum Run Time has been satisfied.

HVAC Operation w/ Heat/Cool Relays

If the user has configured the WHP to control Individual Heating and Cooling relays the following sequence of operation occurs during a heating or cooling demand.

NOTE: If you configure the WHP to look for a proof of flow Enable signal from the Loop Controller then the following sequence assumes a request was made by the WHP during a demand condition and that the Loop Controller gave permission for the WHP to operate its heating or cooling. Otherwise, the WHP will ignore the Enable signal and operate anytime there is a heating or cooling demand.

Once a heating or cooling demand exists, the following conditions must be met before any relays can be activated:

a. Make sure any stages of the opposite mode are staged off.

b. Verify the system has been configured for at least one stage of heating or cooling.

c. Make sure the Minimum Cycle Time has been satisfied.

d. If the last mode was the opposite demand mode, make sure the Changeover Delay has been satisfied.

e. Check the current Minimum Off Timer to make sure this stage has been off long enough since the last time it was cycled on and back off.

f. If there is more than 1 stage, check the Minimum Run Time from the previous stage to be sure it has elapsed before activating the second stage.

g. Make sure the Space Temperature Demand is the full amount of Deadband from the setpoint before activating the second stage.

h. Once the compressor or stage 2 has been turned off, a Minimum Off Time must be satisfied before it can stage on again. A Minimum Cycle time can also be utilized to limit the number of times per hour that the compressor can be activated. If you don't need this limitation, set the Minimum Cycle Time to be shorter than the Minimum Run Time setpoint.

i. If the Reversing Valve was configured to cycle with the compressor, it will now turn off also. It can be configured to remain active until the opposite mode of operation is called for to reduce wear on the valve.

WHP Loop Controller Sequence of Operations

Summary

The Water Source Heat Pump Loop Controller waits for a Request to Run signal from a Heat Pump or from a Binary Contact Closure. Once the request is received the Loop Controller activates a Pump to initiate water flow to the Heat Pumps. Once the pump is activated and proof of flow has been determined, a Global is broadcast to all Heat Pumps to enable them to go ahead and run their compressors. The main goal of the Loop Controller is to provide water flow and to maintain the loop water temperature by monitoring either the Loop Inlet or Loop Outlet temperature. If a higher temperature is required, Heat Addition is enabled. If the temperature needs to be lowered, Heat Rejection is enabled.

Once the Loop Controller has been activated by a request, it will run for a minimum of 15 minutes to prevent cycling on and off due to borderline requests from the Heat Pumps.

If a Fire Alarm is detected, the Loop Controller generates a Global broadcast to all Heat Pumps to turn off.

If the High Pressure option is configured, the Loop Controller can generate a Global broadcast to force the Heat Pumps to open their Isolation Valves to reduce loop pressure if the high limit has been exceeded.

Pump Control

If WattMaster Water Source Heat Pump Controllers are used in conjunction with the Loop Controller, a Global Binary signal from the attached Heat Pumps sends a Request to run or Enable to Run command to the Loop Controller. If the Loop Controller is used in a stand alone configuration, a contact closure on the AIN 2 of the Analog Expansion board gives the controller a request to run. When a request to run is received, the Loop Controller activates a pump to initiate water flow to the heat pumps. The pumps can either be constant flow or controlled by a VFD. If the request goes away for at least one minute, the request to run command is removed. If the loop controller has been running a minimum of 15 minutes then it can be turned off, since there is no longer a request to run. If the proof of flow is lost while the pumps are running, the pump is shut off immediately if the changeover to the Standby Pump had already been made.

The pumps are Lead/Lag controlled based on a user definable number of hours. If one pump exceeds the other pumps run time by this amount, the lead is changed until that

pump exceeds the first pumps run time by the same amount. This keeps both pumps with roughly the same number of hours on each pump. Changeover occurs at the time the run time setpoint is exceeded. The running pump is shut off at the same time the standby pump is energized, this prevents any down time or alarms. The unit can be configured to control either the Loop Inlet temperature or the loop outlet temperature.

A user adjustable low outdoor air temperature setting of XX degrees will allow the unit to run the pumps continuously for protection against freezing.

If the pump is constant volume, and the pump has been started, it has 3 seconds to generate flow or the standby pump is activated. If the pump is controlled by a VFD, once it starts, it has 60 seconds to generate flow and if it doesn't the standby pump is activated. If the standby pump fails, an alarm is generated and the Loop controller deactivates any active heat rejection or addition stages. At the same time an alarm is generated, we energize relay #5 on the Loop Controller board so that it may used to turn on a local alarm signal.

Loop flow can be determined by a binary contact closure on input #3 or a 0 to 50 PSI pressure sensor on input #3. If a pressure sensor is used, the user can program the pressure setpoint that needs to be met for proof of flow.

Pump VFD Control

An optional Pump VFD signal can be modulated if the system is configured for proportional control and a pressure sensor is attached to analog input #3.
At a user defined rate, the VFD signal is ramped up when the pressure is below a user defined setpoint by a user defined deadband. The signal ramps down when the pressure exceeds the setpoint by the deadband value. If the pressure ever exceeds the high pressure setpoint, an emergency override activates and begins cutting the VFD signal in half each time the control loop is polled by the software. This protects against run away over-pressurization.

The pump relay outputs are still activated and Lead/Lagged as described above and the pump relay remains on until the Request signal is removed, provided it has been operating for at least 15 minutes.

Compressor Control

Anytime a pump is running and proof of flow has been established, the compressor output is activated.

Heat Rejection Control

If the compressor is not running, no heat rejection can be active. If any heat rejection is still active when the compressor is turned off, the heat rejection will be immediately removed, without regard to any minimum run or off times.

Heat rejection cannot be active at the same time as heat addition, so any heat addition is removed or staged off before the heat rejection can be started.

A maximum of 8 stages of heat rejection can be controlled.

Staged Heat Rejection

Heat Rejection is staged up based on a different deadband level for each stage. Basically, if the user programmed a 2° deadband, then the first stage could activate at the setpoint, stage 2 would activate 2° above the setpoint, stage 3 would activate 4° above the setpoint, etc...

Staging down is calculated in the same manner, except the water temperature would need to drop below the setpoint by the deadband amount. If stage 3 was activated at 4° above setpoint, it would de-activate when the temperature fell to within 2° of setpoint, stage 2 would de-activate at setpoint and stage 1 would de-activate 2° below setpoint.

A user defined staging up and down interval must be met before any heat rejection stages can be added or removed. If the selected Water Temperature is above the current staging level and the timer has been satisfied, an additional stage can be added, up to the maximum available 8 stages. If the selected Water Temperature is below the staging down level and the timer has been satisfied, a stage can be removed.

Heat Addition Control

If the compressor is not running, no heat addition can be active. If any heat addition is still active when the compressor is turned off, the heat addition will be immediately removed, without regard to any minimum run or off times.

Heat addition cannot be active at the same time as heat rejection, so any heat rejection is removed or staged off before the heat addition can be started.

A maximum of 4 stages of heat addition can be controlled or proportional heating can be configured, and an analog output signal will be modulated to control the heat.

Staged Heat Addition

Heat Addition is staged up based on a different deadband level for each stage. Basically, if the user programmed a 2° deadband, then the first stage could activate at the setpoint, stage 2 would activate 2° below the setpoint, stage 3 would activate 4° below the setpoint, etc...

Staging down is calculated in the same manner, except the water temperature would need to increase above the setpoint by the deadband amount. If stage 3 was activated at 4° below setpoint, it would de-activate when the temperature rises to within 2° of setpoint, stage 2 would de-activate at setpoint and stage 1 would de-activate 2° above setpoint.

A user defined staging up and down interval must be met before any heat addition stages can be added or removed. If the selected Water Temperature is below the current staging level and the timer has been satisfied, an additional stage can be added, up to the maximum available 8 stages. If the selected Water Temperature is above the staging down level and the timer has been satisfied, a stage can be removed.

Proportional Heat Addition

If the Water Temperature is below the addition setpoint, a Boiler Enable relay is activated. If the Water Temperature rises 1° above the setpoint the Boiler Enable relay is de-activated.

At a user defined rate, the analog output signal is proportionally controlled from 0.0 VDC at 1° above setpoint to the full 10.0 VDC signal as the water temperature drops below the setpoint by the user defined deadband amount. If a 5° deadband was entered, the maximum voltage would be reached at 4° below the setpoint and the minimum voltage would be set at 1° above the setpoint. Since this is strictly proportional control, at 1.5° below setpoint the controller would set 5.0 VDC since that would be half the deadband amount.

Water Temperature Alarming

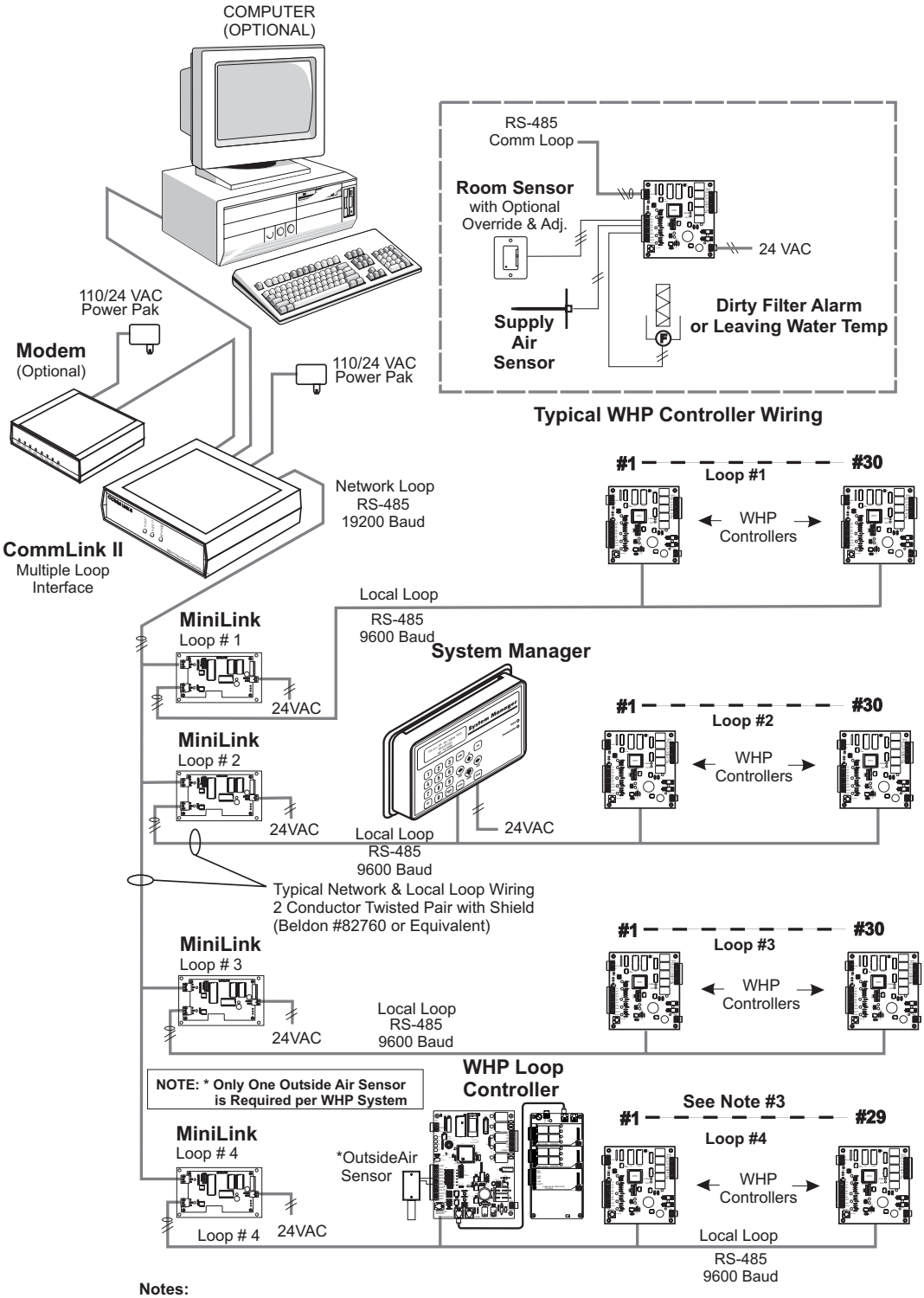
The controlling water temperature is monitored to prevent it from exceeding both a user defined High and Low Alarm Limit. If either limit is exceeded for a user defined length of time, an alarm is generated and the compressor output is de-activated. If the high limit is exceeded, the heat addition outputs are de-activated and if the low limit is exceeded, the heat rejection outputs are de-activated. The alarming and shutdown only pertains to the controlling water temperature. This does not affect the pump operation.

If a external manual alarm reset button is connected between ground and input #5, All outputs are turned off and ALL timers are reset. This forces the loop controller to stage off. This reset WILL shut down the pumps and force them to restart!

Fire Alarm

If the Fire Alarm is activated on input #1 of the Analog Input Expansion Board (Contact OPENS for Alarm!) then ALL outputs and timers are reset and held off for the duration of the Fire Alarm signal.

If the Fire Alarm is not required, input #1 of the Analog Input Expansion Board must have a shorting wire to ground to allow the equipment to operate.



Notes:

1.) 24 VAC Must Be Connected So That All Ground Wires Remain Common.

2.) All Wiring To Be In Accordance With Local And National Electrical Codes and Specifications.

3.) The Local Loop With The Loop Controller Installed Can Only Have Up To 29 WHP Controllers Attached As The WHP Loop Controller Occupies Address #30.

4.) Systems may consist of up to 20 Local Loops (600 WHP Controllers). Consult factory for systems that exceed these quantities.

Figure 1-3: Typical WattMaster WHP System

Notes:

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Installation and Wiring

Tips Before Beginning Installation

Take a few moments to review the following before beginning installation of the WattMaster WHP System.

- Familiarize yourself with all system components and review all documentation. Pay special attention to "Cautions" and "Warnings" since these may keep you from experiencing unnecessary problems.

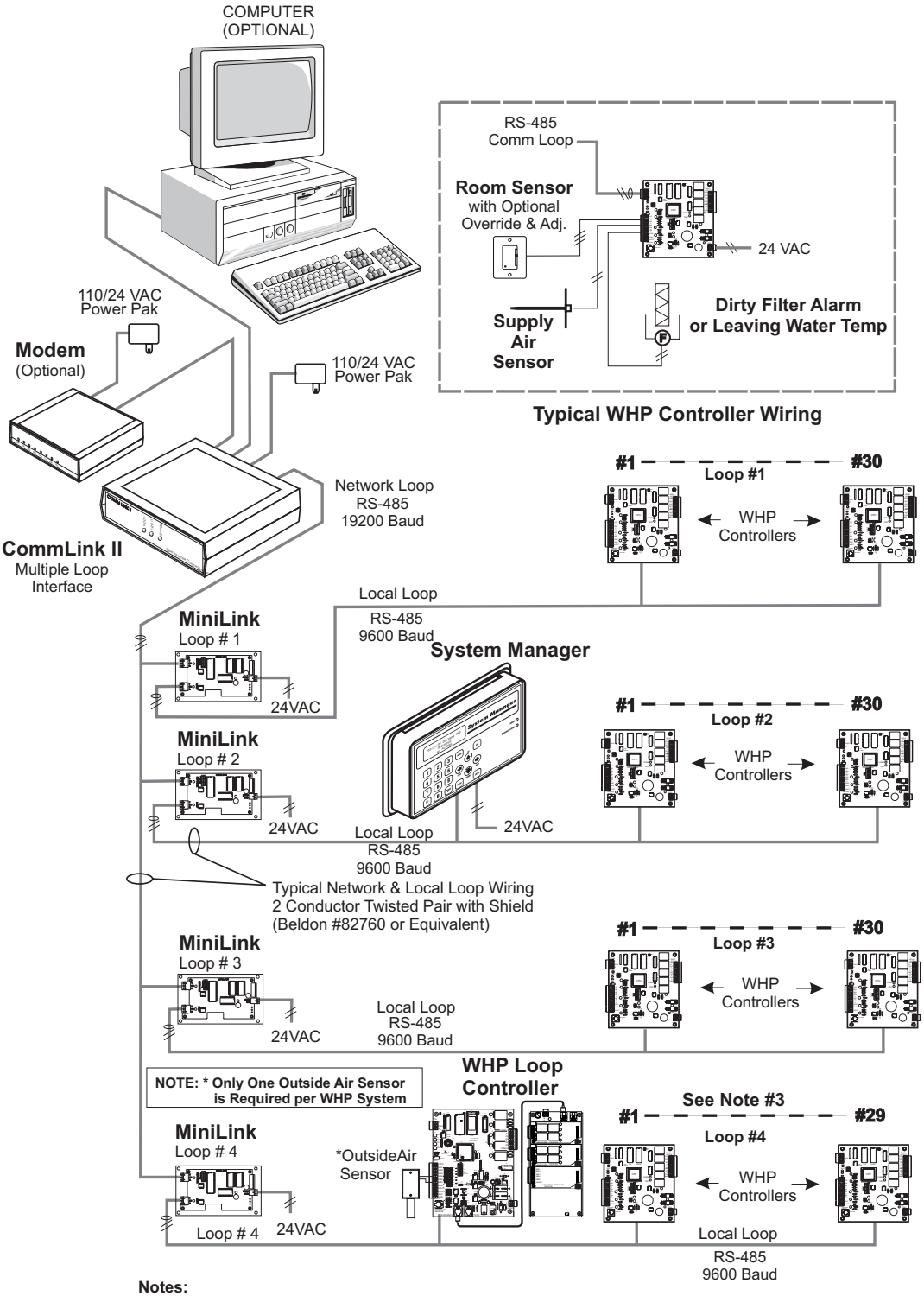
- Before installing controllers, be sure to tag it with its appropriate location. It is also best to set the controller address switches before mounting. Use the WHP Address Worksheet to list all WHP unit locations. This will assist you greatly when setting up the system.

- Be sure and install all wiring according to local, state, and national electric codes.

- Pay close attention to communication wiring since the most common mistakes are made in this area. Polarity is the most important rule. Make notes on your wiring diagrams as to which color wire you will be using on each terminal.

- When in doubt - ask! Contact your local WattMaster distributor if you have any questions. The only dumb questions are the ones you don't ask.

- Remember - each electronic device contains only one puff of smoke. If you release it, you have voided the warranty! So please be careful and pay attention.



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4.) Systems may consist of up to 20 Local Loops (600 WHP Controllers). Consult factory for systems that exceed these quantities.

Figure 2-1: System Overview

Communications Loops

The Communications Loop is two wire shielded RS-485. The loop is best connected in ***daisy chain*** configuration, meaning the loop is connected from one controller to another. It is not necessary to sequentially address the WHP Controllers in relation to their location on the loop. Cable must be Belden No. 82760 or equivalent.

Tip: Incorrect wiring of the communications loop is the most common mistake made during installation. Before beginning installation, write down the wire color used on each terminal connection and consistently maintain that color code. It is recommended that a continuous wire run be made between devices. Anytime a splice is made in the cable you increase your chance of problems.

Caution: Make sure when you are inserting wires into the terminal blocks that strands of wire do not stick out and touch the next terminal. This could cause a short or erratic operation.

Communications Loop Wiring Overview

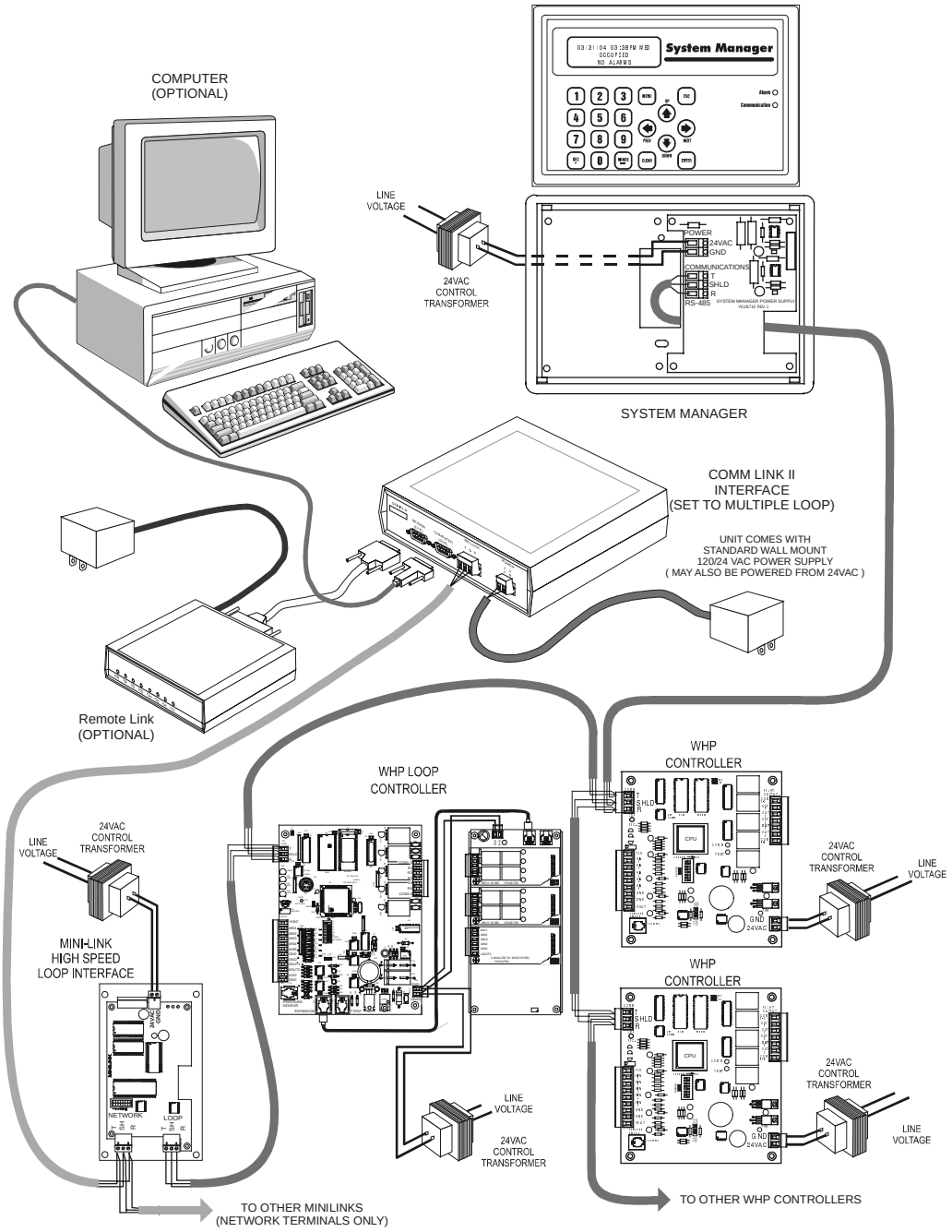


Figure 2-2: **Communication Loop Wiring, Daisy-Chain Configuration**

The daisy chain is the best method for running a communications loop since there is only one starting point and one ending point for each of the communications loops. Even though the daisy chain configuration is preferred, the ***star*** configuration can also be used. If required, a combination of the two can also be used. Remember, the best communication loop wiring is the one which utilizes the minimum number of ***ends*** while using the shortest wiring path.

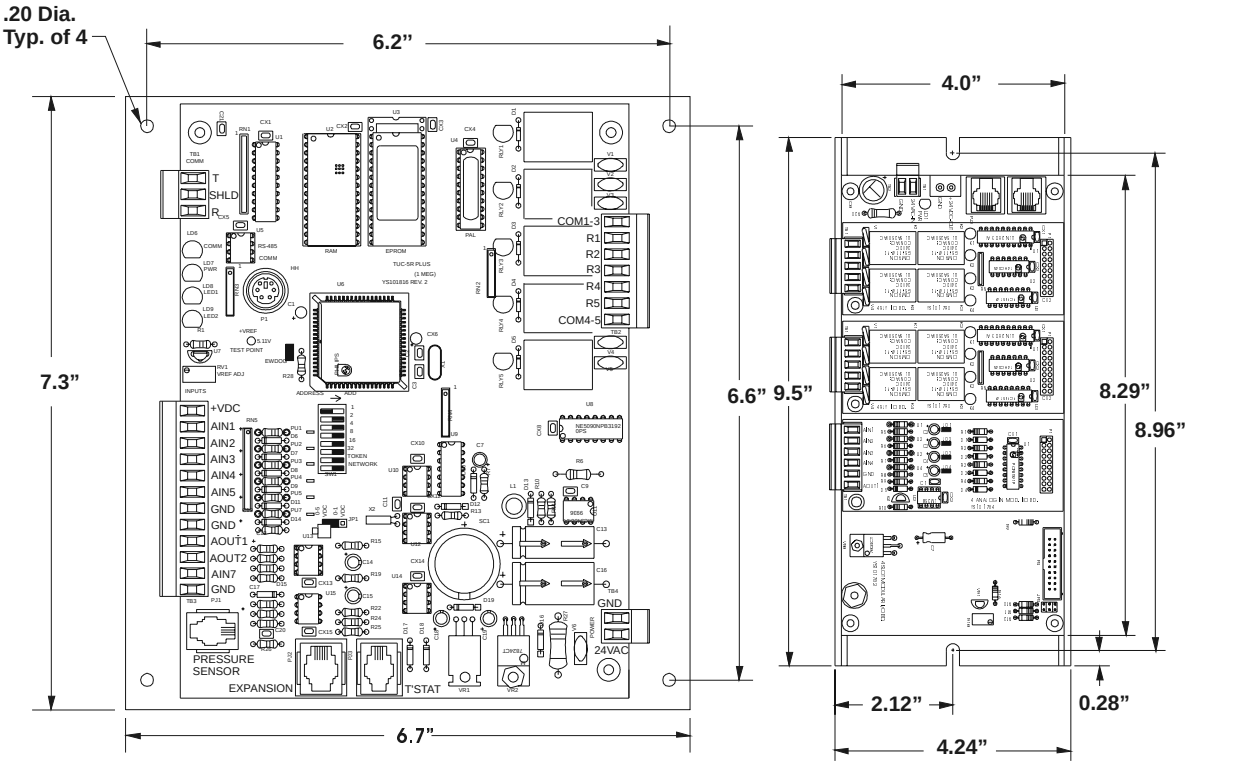
Note: The loop does not have to follow the controller address sequence.

Caution: If the comm loop is not installed in conduit, be careful to position the cable away from high noise devices like fluorescent lights, transformers, VFD's, etc. Conduit is not required for comm loop wiring unless required by local codes.

Make sure CommLink jumper is set for "Multi".

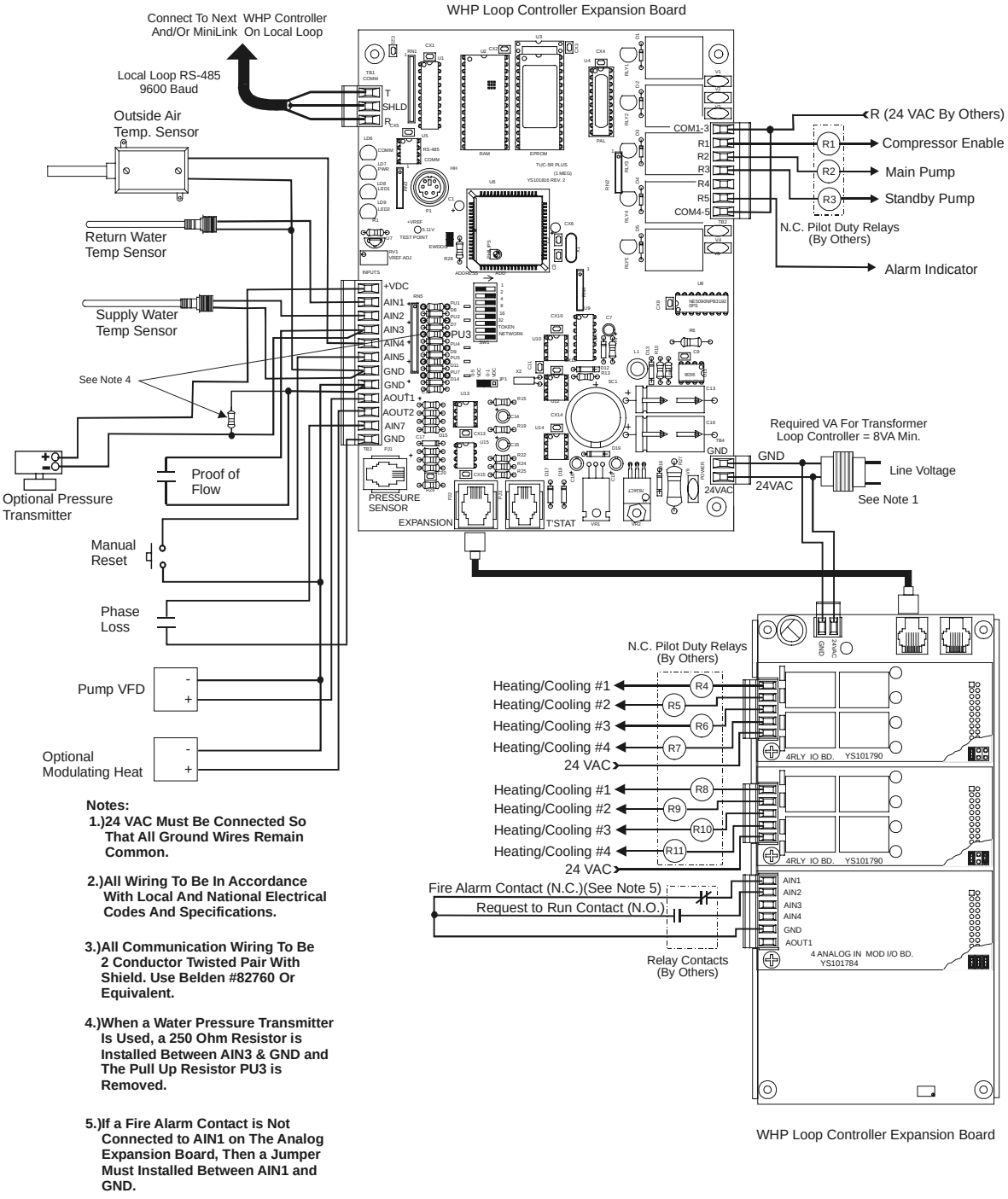
WHP Loop Controller

The ***WHP Loop Controller*** may be installed in any convenient protected location. It is recommended that the loop controller be mounted indoors in a secure location, that is not subject to extremes in temperature or moisture.



WHP Loop Controller Main Board **WHP Loop Controller Expansion Board**

Figure 2-3: **WHP Loop Controller**



Notes:

1.)24 VAC Must Be Connected So That All Ground Wires Remain Common.

2.)All Wiring To Be In Accordance With Local And National Electrical Codes And Specifications.

3.)All Communication Wiring To Be 2 Conductor Twisted Pair With Shield. Use Belden #82760 Or Equivalent.

4.)When a Water Pressure Transmitter Is Used, a 250 Ohm Resistor is Installed Between AIN3 & GND and The Pull Up Resistor PU3 is Removed.

5.)If a Fire Alarm Contact is Not Connected to AIN1 on The Analog Expansion Board, Then a Jumper Must Installed Between AIN1 and GND.

Figure 2-4: WHP Loop Controller Wiring

Warning: Polarity is **very** important when connecting power to the controllers! The grounded side of the control transformer **must** be connected to the terminal labeled GND on the controller. If a single transformer is used to power more than one controller you **must** connect GND-to-GND and 24VAC-to-24VAC on each controller. **Failure to observe polarity will result in damage to one or more components in your system.**

The WHP Loop Controller requires the following electrical connections:

-24VAC Supply Voltage..... 2 Conductors (18 Ga. Min.)
-Communications Loop .....2 Conductor twisted pair with shield (18 Ga. Minimum)
(Belden #82760, WattMaster Cable or equivalent)
-Supply Water Temperature Sensor.....(24 ga. Min.) 2 Conductors
-Return Water Temperature Sensor.....(24 ga. Min.) 2 Conductors
-Outside Air Temperature Sensor.....(24 ga. Min.) 2 Conductors
-Loop Pressure Sensor (Optional).....(24 ga. Min) 2 Conductors
-Fire/Smoke Alarm Contacts.....(24 ga. Min.) 2 Conductors
-Loop Pressure Switch.....(24 ga. Min) 2 Conductors
-Manual Reset Switch.....(24 ga. Min) 2 Conductors
-Request to Run Contacts.....(24 ga. Min) 2 Conductors
-Analog Outputs.....(24 ga. Min) 2 Conductors
-Binary Outputs.....(24 ga. Min) 2 Conductors

Tip: After making all electrical connections it is advised to unplug all terminal blocks on the WHP Loop Controller until you are ready to begin the checkout procedure. This may help to prevent damage if wiring errors occur elsewhere in the system during installation or start-up.

WHP Loop Controller Addressing

The WHP Loop Controller must be set for address #30. See address setting instructions for the WHP Loop Controller that follow. A maximum of 29 WHP Controllers are allowed on the loop that contains the WHP Loop Controller. All other loops may have 30 WHP Controllers.

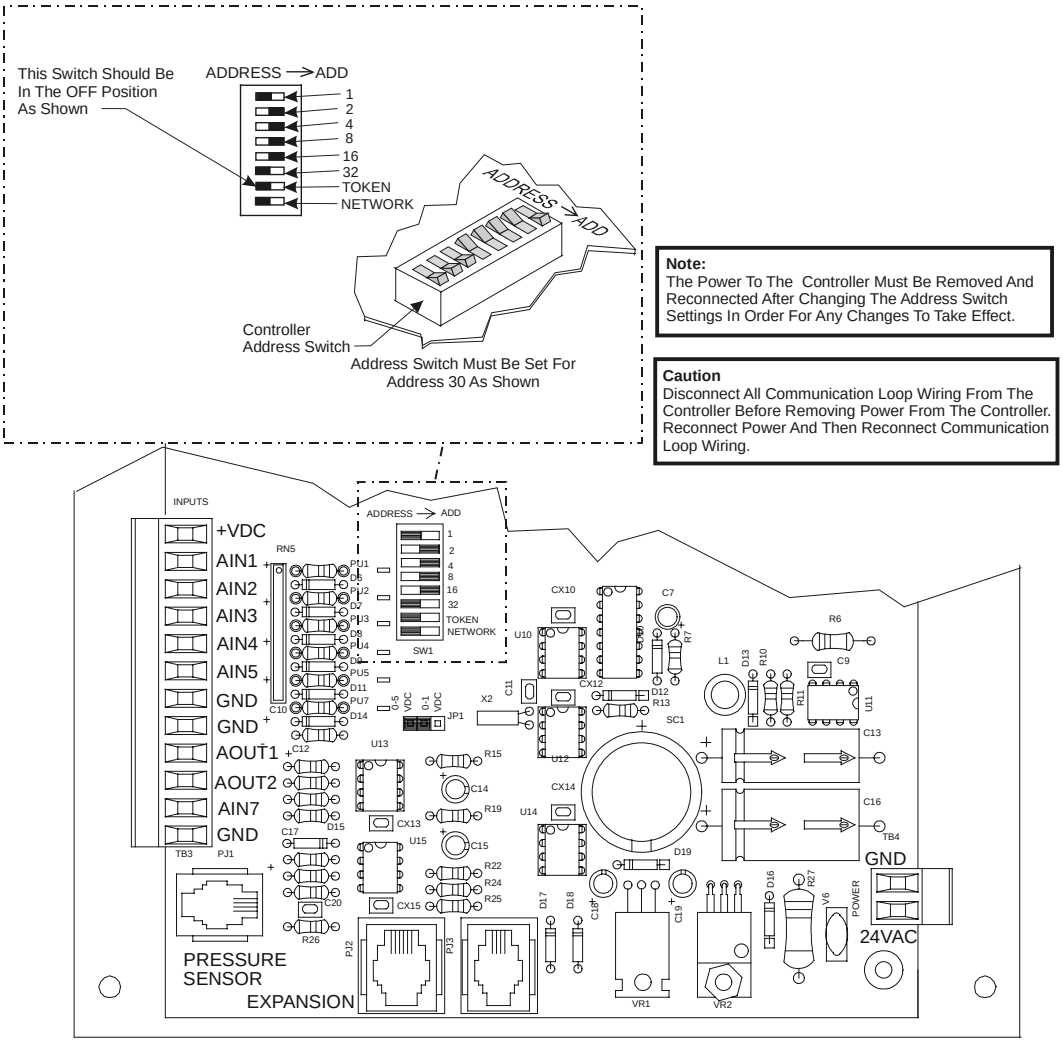


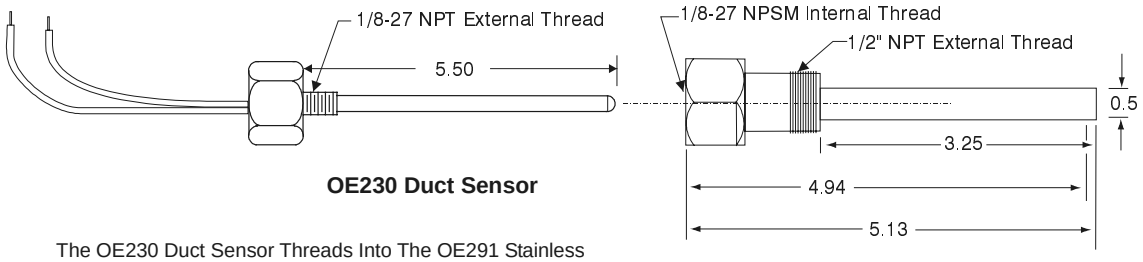
Figure 2-5: WHP Loop Controller Address Switch Setting

Supply & Return Water Temperature Sensors

Sensors for monitoring supply and return water temperature are available in two main types, fluid immersion temperature sensors (See **Figure 2-6**) and strap-on sensors (See **Figure 2-7**). Both are 0-10000 ohm thermistor type sensors. The fluid immersion sensor generally has better accuracy than the strap-on type but either is suitable for typical water source heat pump temperature requirements. The fluid immersion type sensor requires that a thermowell be installed in the pipe and the strap-on type, as its name implies, simply straps around the outside of the pipe. The fluid immersion sensor requires that the pipe be at least 4" in diameter in order to accept the thermowell. The strap-on type sensor is adjustable for use on 1/2" to 6" or larger diameter pipe.

The fluid immersion sensor is provided with a 4" long stainless steel thermowell. It has ½" MPT external threads and ½" FPT internal threads. A ½" FPT fitting to accept the thermowell must be provided by others in the pipe to be monitored, for connection of the thermowell. The thermowell is screwed into the ½" FPT fitting installed by others in the pipe and the sensor probe is then screwed into the ½" FPT fitting on the thermowell.

Leads Are Non-polarized.
Butt Splice Leads To 24 Gauge Wire Minimum. Connect Leads To "Analog In" And "Ground" At Controller.



OE230 Duct Sensor

The OE230 Duct Sensor Threads Into The OE291 Stainless Steel Thermowell. The OE291 Thermowell Threads Into A 1/2" FPT Elbow or Tee in the Water Piping of the Water Coil Where You Wish to Measure the Water Temperature. The Pipe must be a minimum of 4" Diameter or an Extended Tee and Bushing Configuration Must be Used to Accommodate the Length of the Thermowell Assembly.

OE291 Stainless Steel Thermowell

Figure 2-6: Duct Sensor with Thermowell

The strap-on type sensor has a brass housing that senses the water temperature through contact with the exterior surface of the pipe. The sensor should be mounted in contact with the underside of the pipe in order to insure accurate temperature readings. The sensor assembly is secured to the pipe by using the supplied wire ties to wrap and secure the sensor to the pipe. Thermal conductive compound is also supplied to insure a good thermal connection with the pipe. The sensors are supplied with 3 foot long wire leads.

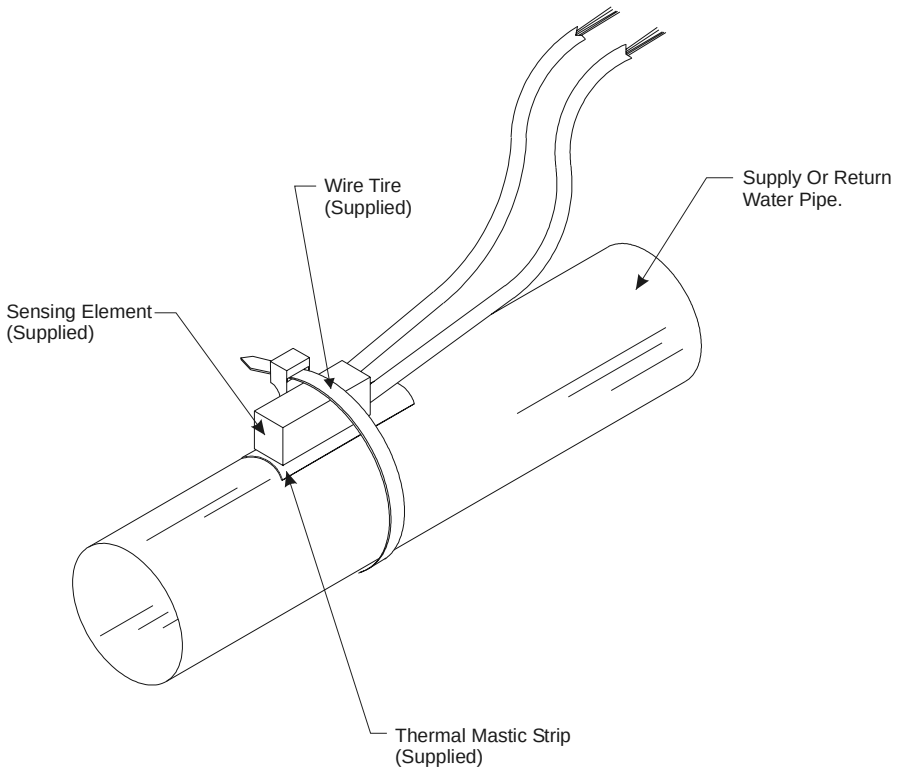


Figure 2-7: **Strap-On Water Temperature Sensor**

Outside Air Temperature Sensor

The ***outside air sensor*** must be located where it will not be affected by direct sun or heat producing equipment. Mounting under the eve of a roof is often a good choice.

> **Caution:** Complaints of inaccurate outside sensor readings are very common and can almost always be shown to be the result of poor sensor location.

Note: All temperature sensors supplied with the system utilize the same thermistor type sensing element. For troubleshooting sensor problems refer to the TEMPERATURE SENSOR RESISTANCE CHART at the end of Section 4.

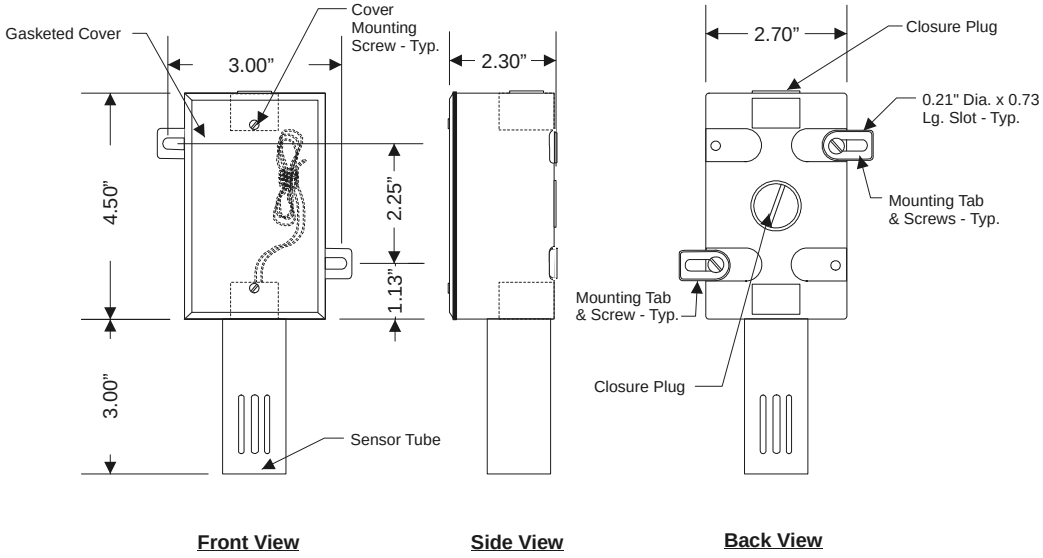


Figure 2-8: Outside Air Temperature Sensor

CommLink II Interface

The ***CommLink II Interface*** provides for communications between the MiniLink communication interfaces installed on the system. The CommLink II is required for proper communications, even if a PC is not used. Locate the CommLink II near the computer or modem if they are installed on the system. The cable connections between the CommLink II and the computer or modem should be kept to less than twenty-five feet. The CommLink II comes complete with computer and modem cables, and a plug-in power supply.

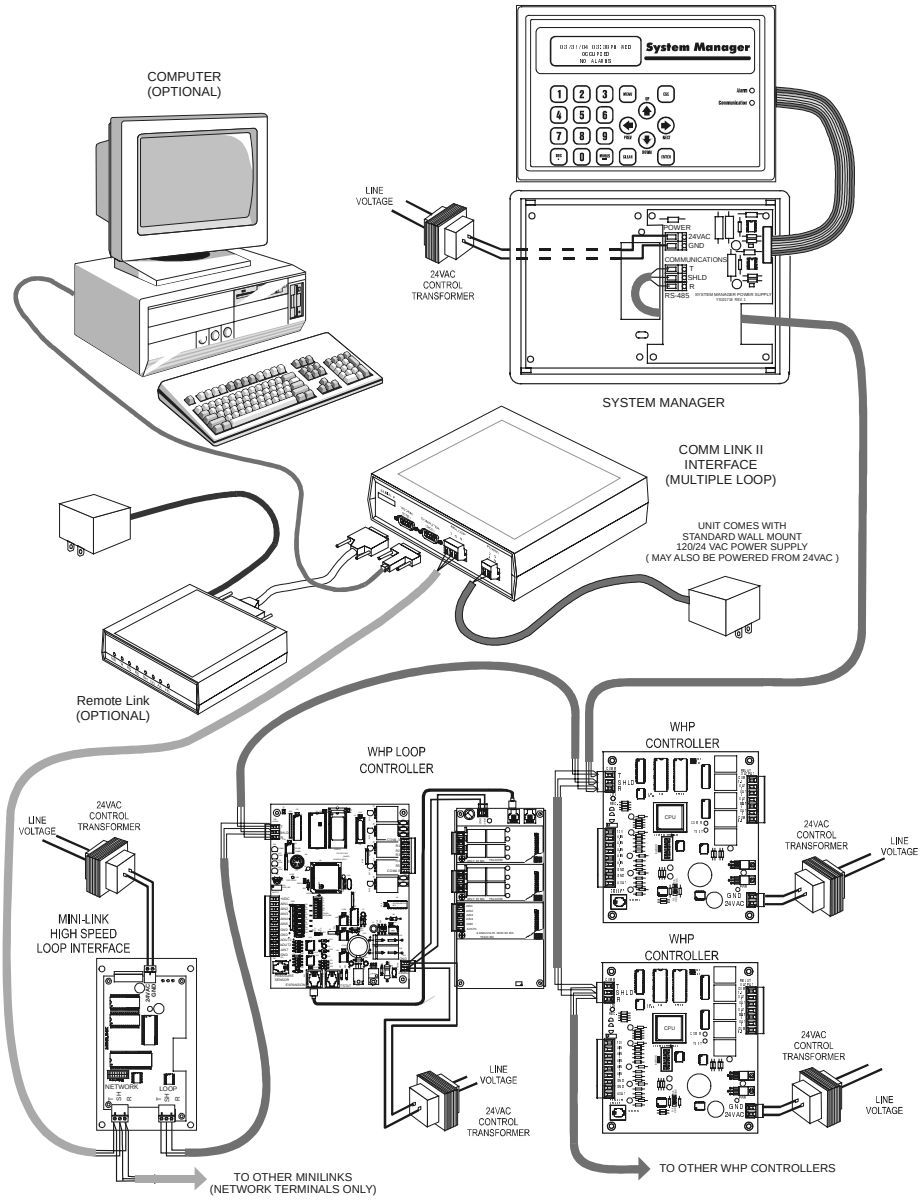


Figure 2-9: **CommLink Interface Wiring**

WHP Controller

The ***WHP Controller*** may be installed in any convenient protected location. Observe the recommended environmental limitations for the WHP Controller when selecting a installation location. The environmental limitations are a temperature range of 10°F to 149°F, and a maximum operating humidity of 90% RH non-condensing.

The WHP Controller may be mounted by fastening to a flat surface through the mounting plate. The unit is mounted by four (4) screws in the corners. Select the correct screws or other fasteners for the type of mounting material being utilized.

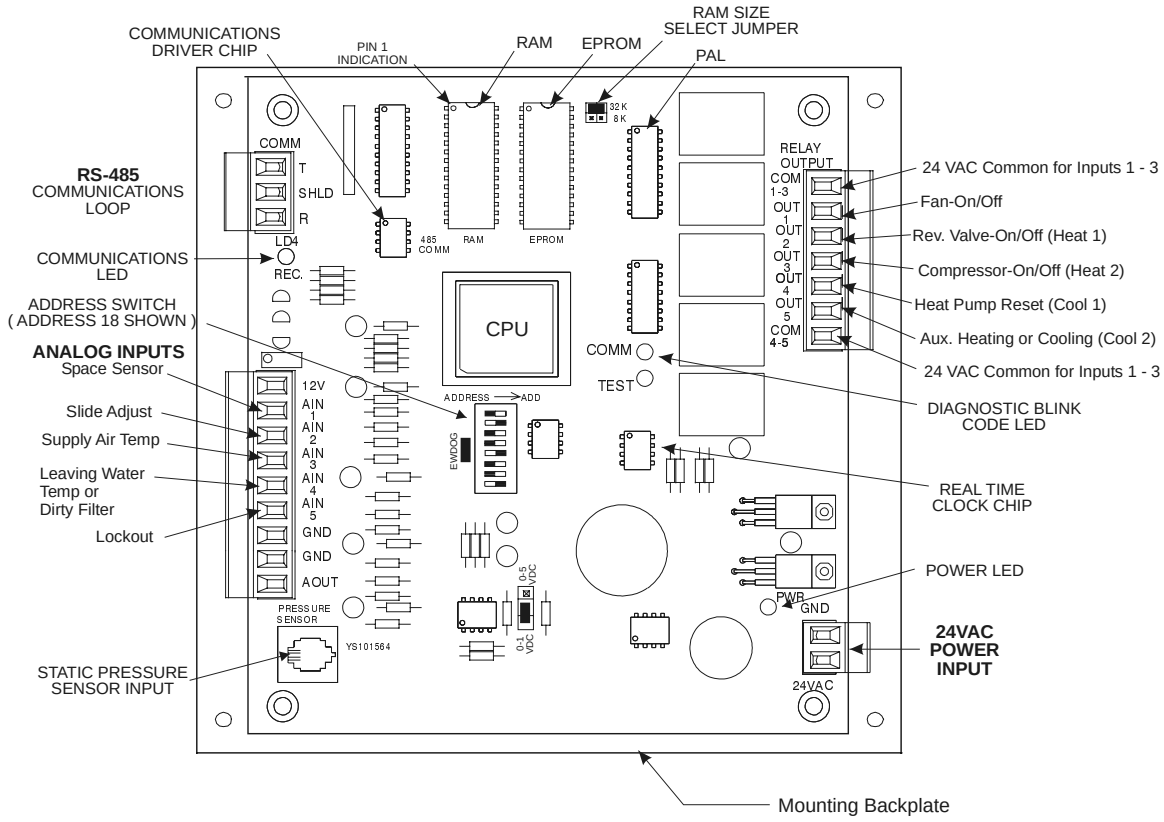


Figure 2-10: WHP Controller

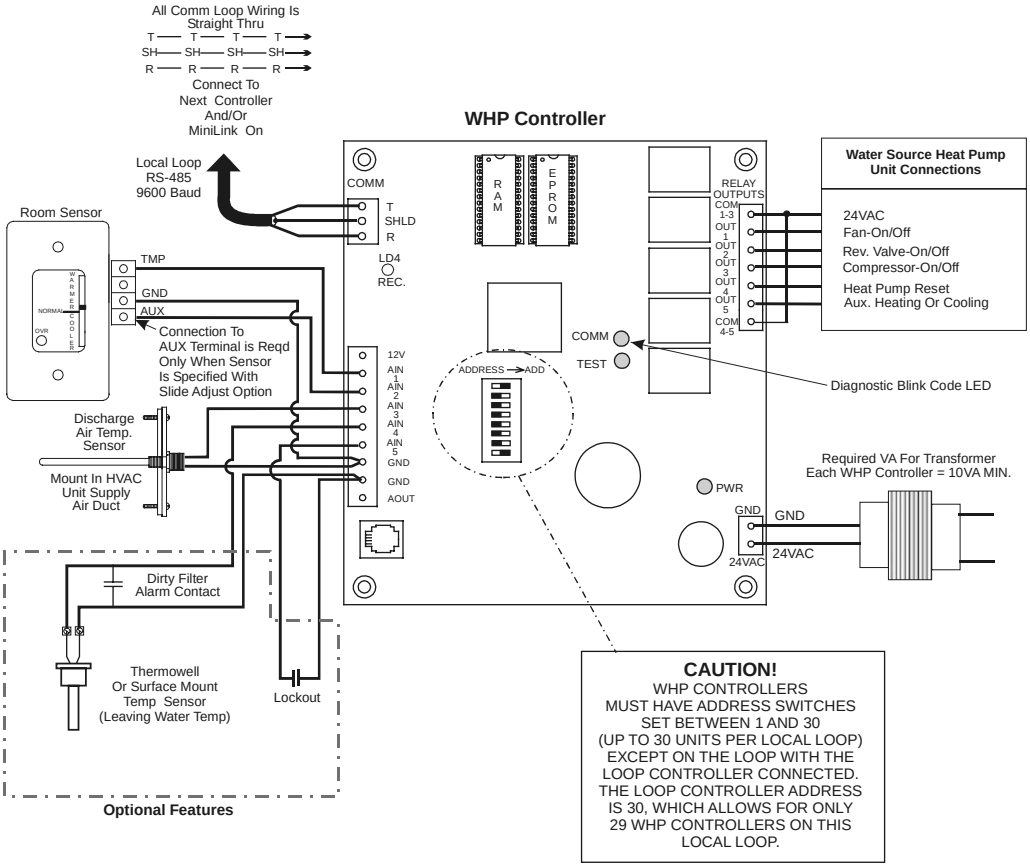


Figure 2-11: WHP Controller Wiring

Warning: Polarity is **very** important when connecting power to the controllers! The grounded side of the control transformer **must** be connected to the terminal labeled GND on the WHP Controller. If a single transformer is used to power more than one WHP Controller you **must** connect GND-to-GND and 24VAC-to-24VAC on each WHP Controller. **Failure to observe polarity will result in damage to one or more components in your system.**

Warning: Use **extreme** care not to damage any of the electronic components while mounting the backplate. Mark the holes then remove the WHP Controller from the backplate before drilling.

Do not allow metal shavings to fall onto the circuit boards.

The WHP Controller requires the following electrical connections:
18 Gauge minimum unless otherwise noted.

-24VAC Supply Voltage..... 2 Conductors
-Communications Loop ..... 2 Conductor twisted pair with shield
(WattMaster Cable, Belden #82760 or equivalent)
-Discharge Air Temperature Sensor ..... (24 ga. Min.) 2 Conductors
-Room Air Temperature Sensor.....(24 ga. Min.) 2 Conductors for standard sensor
3 Conductors for sensors with setpoint adjustment
-Outside Air Temperature Sensor..... (24 ga. Min.) 2 Conductors
-WHP Unit Control Wiring ..... (24 ga.Min.) 24 VAC
Fan- ON/OFF
Rev Valve-ON/OFF
Compressor-ON/OFF
Heat Pump Reset
Aux. Heating or Cooling

Tip: After making all electrical connections it is advised to unplug all terminal blocks on the WHP Controller until you are ready to begin the checkout procedure. This may help to prevent damage if wiring errors occur elsewhere in the system during installation or start-up.

WHP Controller Addressing

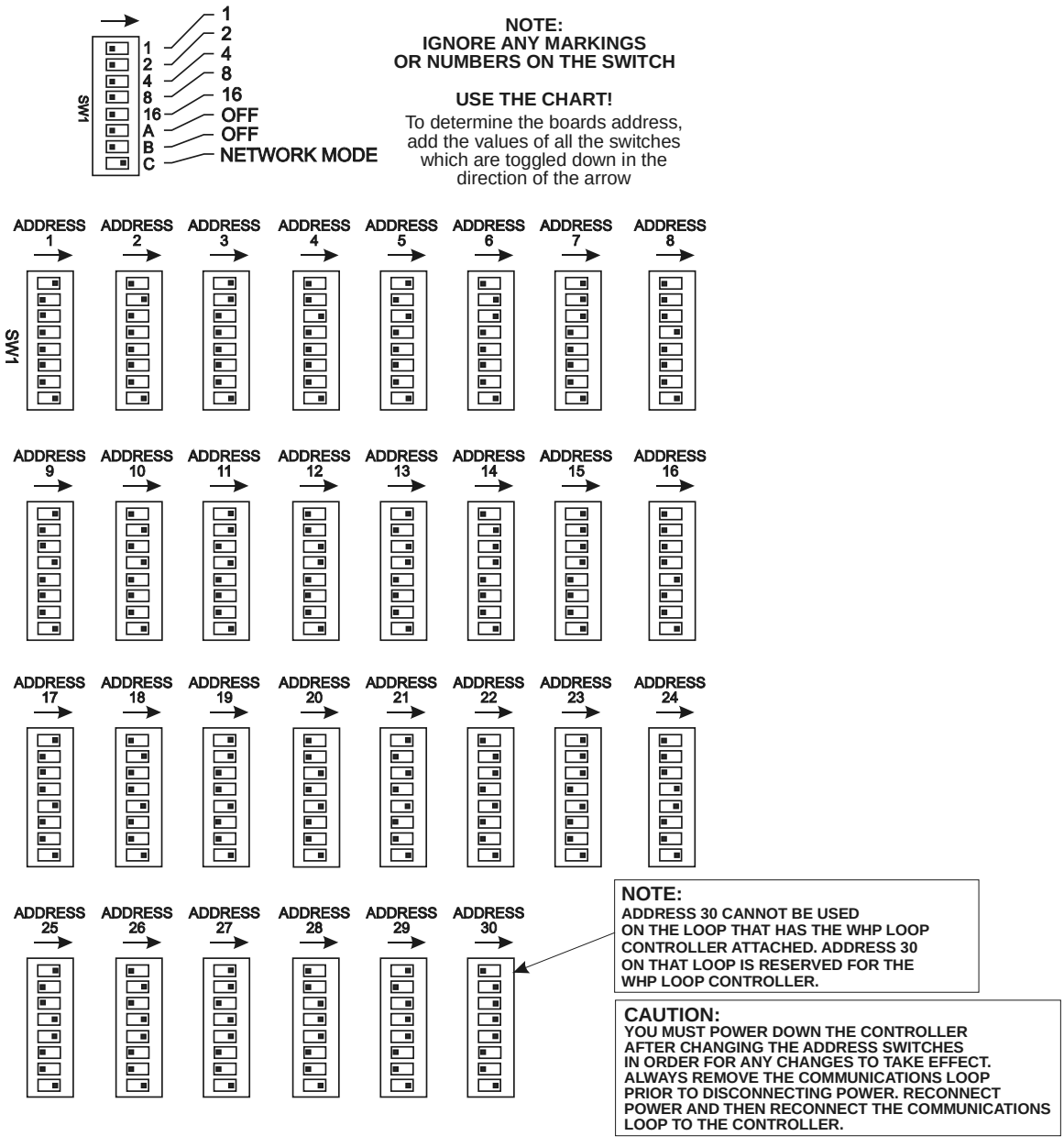


Figure 2-12: WHP Controller Address Switch Setting

MiniLink Addressing

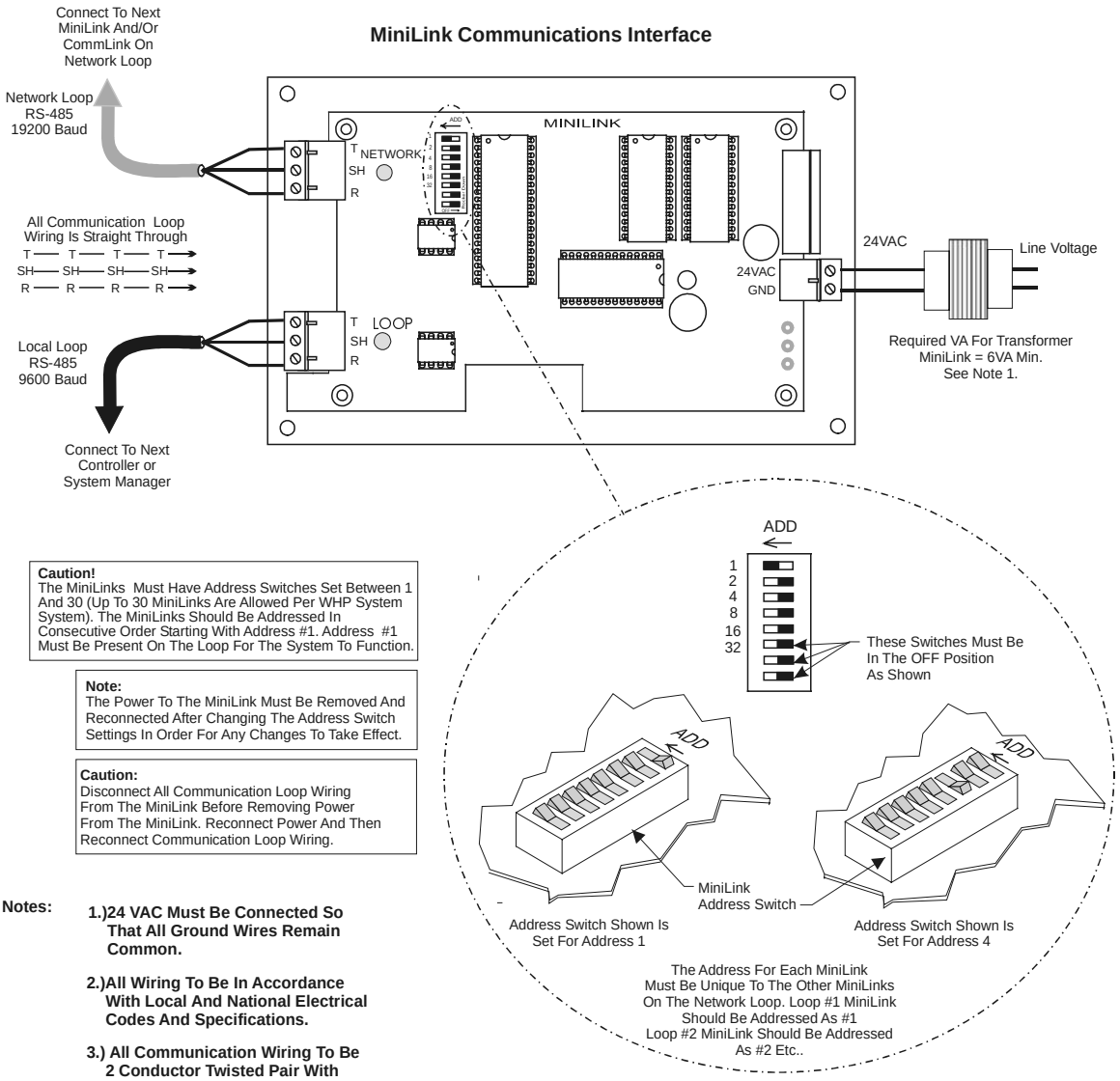


Figure 2-13: MiniLink Address Switch Setting

Room Sensors

The ***room sensor*** uses a patented flush mount design to isolate the temperature sensing element from the housing which mounts flush with the wall surface.

Room sensors should be located on an inside wall away from direct sunlight or heat producing equipment such as computers, copiers, etc. Such devices can adversely affect the accuracy of the sensor.

Although the sensor eliminates most of the effects of thermal coupling to the walls, try to avoid walls which retain large amounts of thermal energy (such as marble or steel). Walls containing either cold or warm air currents should also be avoided whenever possible.

Avoid locating the sensor in dead air areas of a room. This will result in slow response to temperature changes in the space.

Mount the sensor approximately 50-60 inches from the floor for best results.

The room sensor is designed to mounted vertically in a standard 2 by 4 inch electrical box. The sensor may be mounted directly into the drywall where electrical codes do not require low voltage wiring to be enclosed in conduit. See enclosed sheet for dimensional and installation data.

Tip: Be careful when cutting the hole for the sensor or the plastic bezel of the sensor may not completely cover the opening.

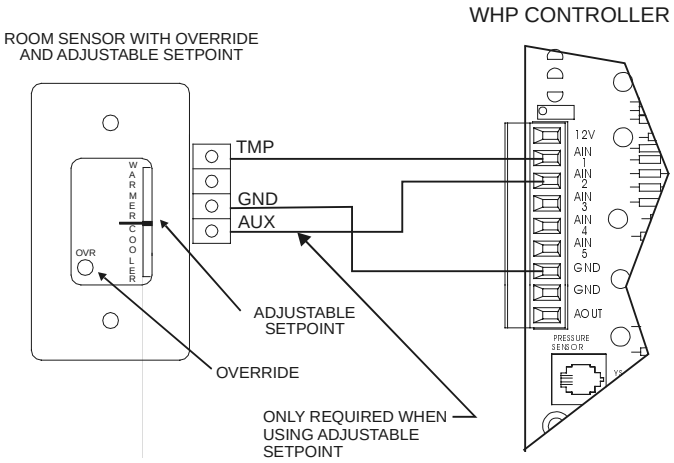


Figure 2-14: Room Sensor Wiring

Connect the terminal labeled GND on the zone sensor to the terminal labeled GND on the WHP Controller Analog Input terminal block. Connect the terminal labeled TMP on the zone sensor to the terminal labeled AIN 1 on the WHP Controller Analog Input terminal block. If the zone sensor has a setpoint adjust slider, then connect the sensor terminal labeled AUX to the WHP Controller AIN 2 terminal block.

Tip: If sensors must be installed on walls which are solid and cannot be penetrated, surface mounted boxes and raceway can be purchased from your local electrical distributor.

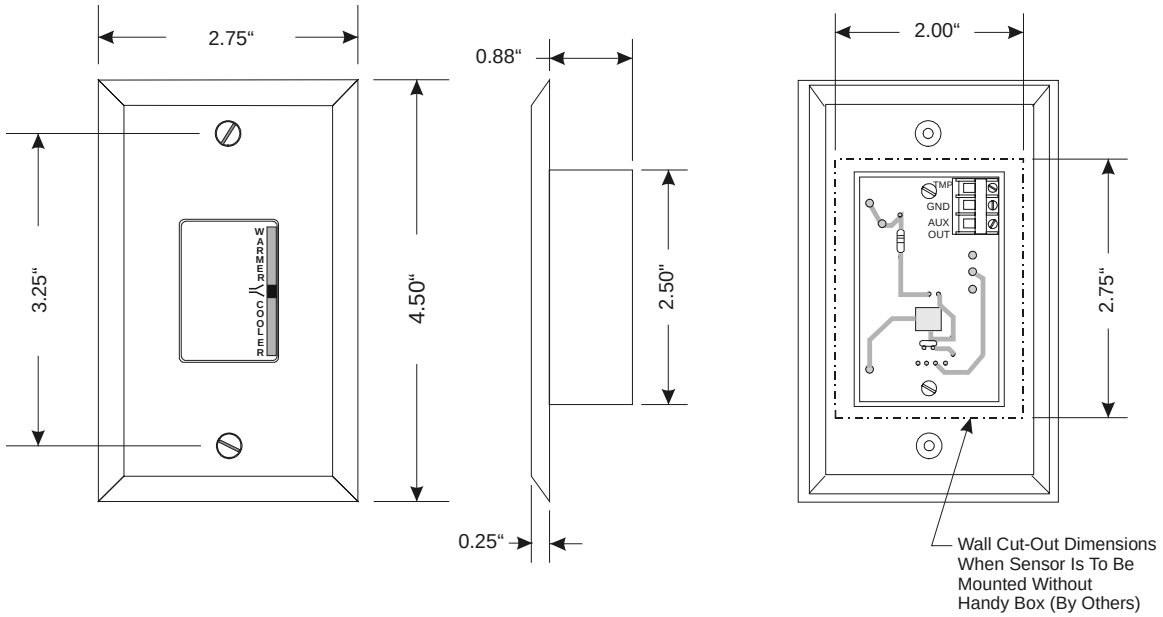


Figure 2-15: Room Sensor

Supply Air Temperature Sensor

The ***supply air temperature sensor*** should be located in the duct, as close to the rooftop unit discharge as possible for best response.

Locate the sensor in the center of the widest part of the duct. Use the supplied template and a 5/16" drill to make a hole for the sensor. Install the gasket over the probe and mount securely to the duct using the supplied sheet metal screws. Be sure the gasket is compressed to provide an air tight seal.

For best accuracy, apply insulation on the outside of the duct, over the sensor. This will help prevent thermal gradients from affecting the sensor.

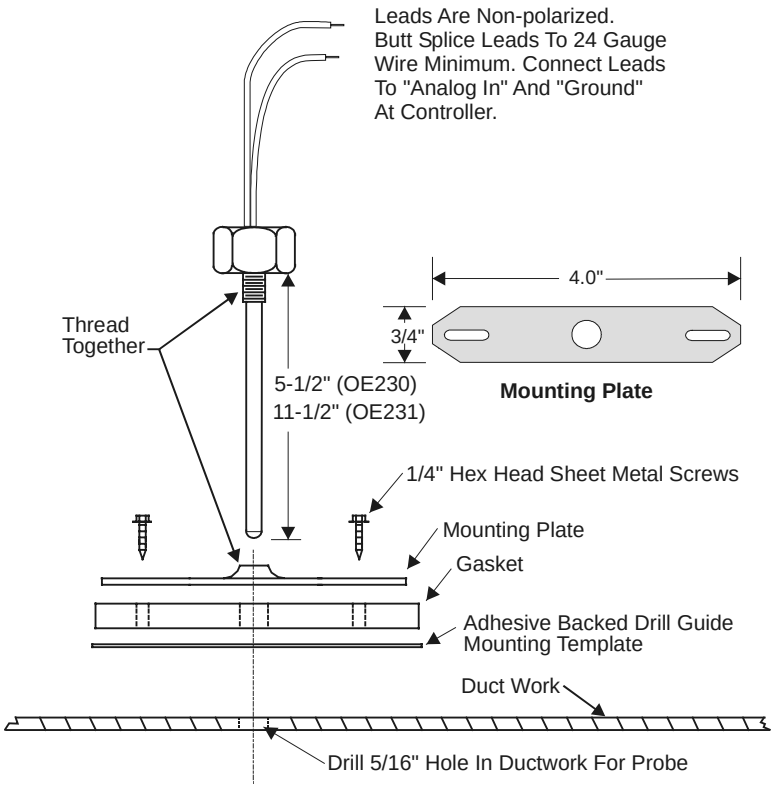
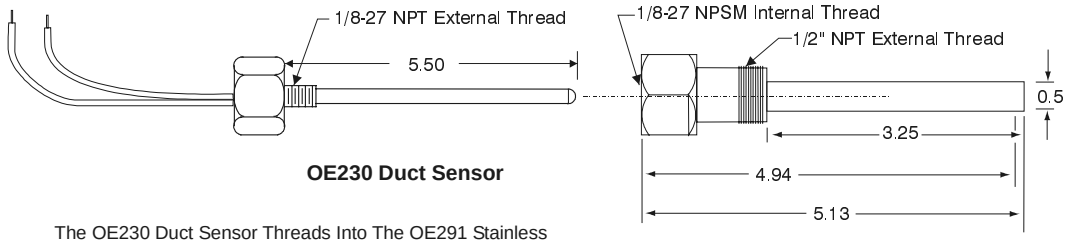


Figure 2-16: **Supply Air Temperature Sensor**

Leaving Water Temperature Sensors

The ***leaving water temperature sensor*** (optional) when used should be located on the leaving water piping close to the water source heat pump unit. Either a thermowell type or a surface mount sensor may be used depending on job requirements.

Leads Are Non-polarized.
Butt Splice Leads To 24 Gauge Wire Minimum. Connect Leads To "Analog In" And "Ground" At Controller.



OE230 Duct Sensor

OE291 Stainless Steel Thermowell

The OE230 Duct Sensor Threads Into The OE291 Stainless Steel Thermowell. The OE291 Thermowell Threads Into A 1/2" FPT Elbow or Tee in the Water Piping of the Water Coil Where You Wish to Measure the Water Temperature. The Pipe must be a minimum of 4" Diameter or an Extended Tee and Bushing Configuration Must be Used to Accommodate the Length of the Thermowell Assembly.

Figure 2-17: Water Temperature Sensor

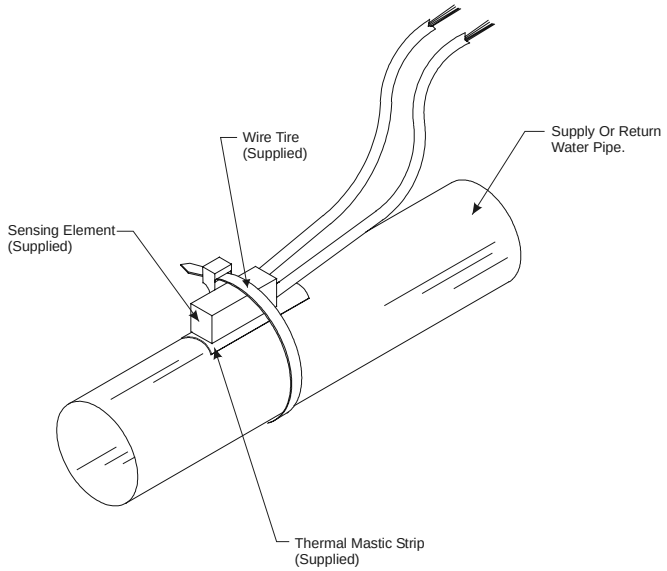


Figure 2-18: Water Temperature Sensor

Section 3

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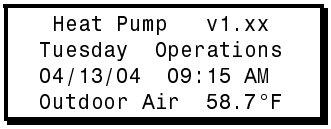
LCD/Keypad Operations

Main Screen

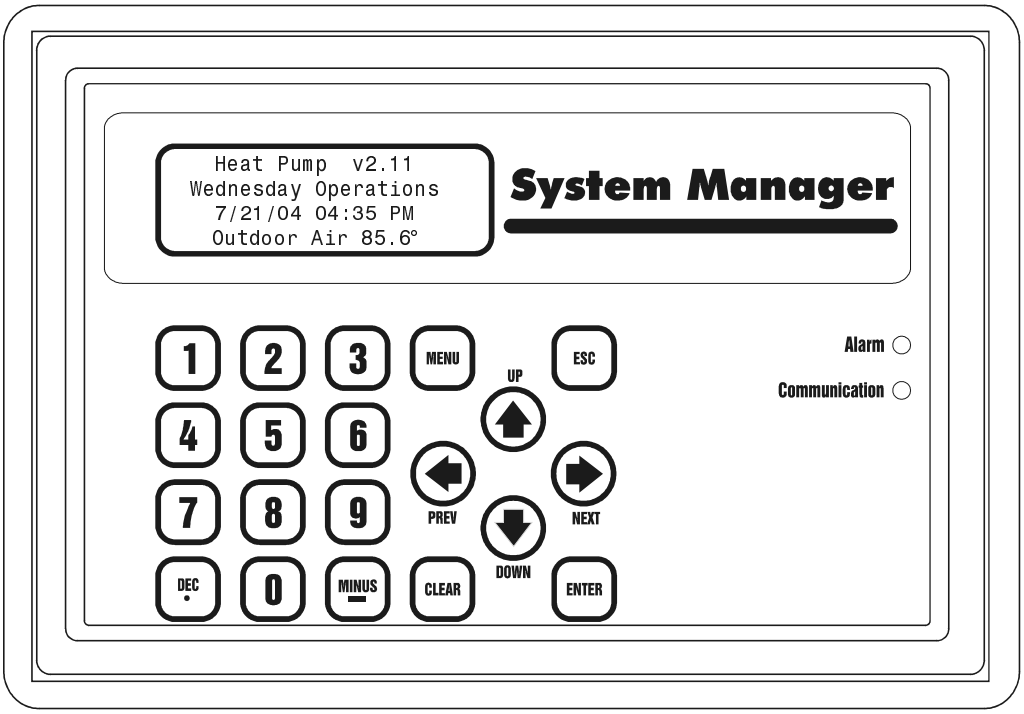


The ***Water Source Heat Pump System Manager*** is the operator's interface to the ***status*** and ***setpoints*** of any WattMaster Water Source Heat Pump (WHP) component on your communications loop. With the System Manager, you can view any temperature or output condition and change any setpoint to fine tune the operations of the total system. All keypad operations are simple and straight-forward, utilizing non-cryptic plain English messages. The System Manager automatically detects the type of unit that has been selected, and displays the appropriate status and setpoint screens. The attractive plastic case of the System Manager allows for placement in any area of your building.

The remainder of this document will lead the user through the system menus and keypad operation.

All user functions are accessed by pressing the Menu button. Once the button is pressed, the Main User Menu is displayed.

System Manager Layout



Keypad Functions

The System Manager keypad is labeled either numerically or as to actual function for that key. Below is a summary of the labeled keys and their functions.

MENU	This key is used to gain access to the first menu, and the user will be notified, on the LCD, if any subsequent use of the key will be required for further access.
ESC	The ESCape key allows the user to abort what they are doing or exit back to previous menus. Also, anytime you want to leave the system unattended you should press the ESC key until the Main Screen appears.
CLEAR	If you make a mistake while entering setpoint data, you can clear the bad data from the display by pressing the Clear key.
ENTER	Use the Enter key to close out a data entry. It can also be used to advance to the next field or screen.
DEC	If entering a setpoint that requires a decimal point, press this key where the decimal is located while entering the value.
MINUS	If you need to enter a negative value, you must press the Minus key before entering the digits for that value.
UP/DOWN Arrows	Use these keys to step forward or backward through Status Screens or Setpoint Data Fields.
LEFT/RIGHT Arrows	If the screen prompts you to use these keys, it is used normally to toggle modes of operation.

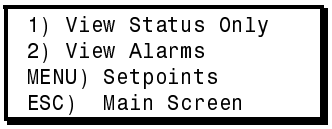
System Manager LED Indicators

There are two LED indicators located on the right hand side of the System Manager.

The top LED indicates an Alarm condition if the Manager detects an alarm condition while polling the system.

The bottom LED is active during actual communications or packet transfers. This LED will normally "flicker" and not remain on constantly.

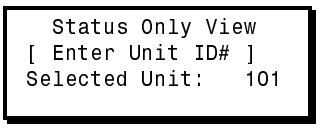
Main User Menu



1) View Status Only	For quick access to an individual heat pump or the loop controller, select this menu item. No passcode is required to access the status of any unit installed on your system.
2) View Alarms	If the System Manager has been configured for Alarm Polling, the user can select this item to get a list of unit addresses that are currently in alarm. If an alarm exists, the Alarm LED will be active on the right side of the panel.
MENU) Setpoints	If you are a Level 2 user, all system setpoints are available to you. These setpoints are accessed via this Menu button.
ESC) Main Screen	When you have finished viewing the system you can exit this menu and return to the Main Screen by pressing the ESC button.

Heat Pump Status Screens

View Status Only



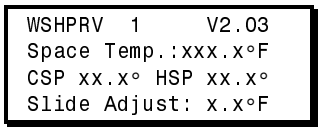
By selecting the View Status Only menu item, you can access any heat pump or the loop controller and read all available temperatures, outputs, and operating conditions for the selected unit. No passcode is required to access these status screens, and no setpoints are available to the user from these screens. To access a unit, enter the Unit ID you wish to view. The Unit ID is actually two separate numbers, combined into one value. The first part of the number contains the Loop Address at which the zone is located. The second part of the number contains the actual Board Address.

EXAMPLE: You would like to view the 3rd heat pump on the 5th loop. Enter 503 as the Unit ID

You would like to view the 12th heat pump on the 24th loop. Enter 2412 as the Unit ID

If you selected menu item #1 View Status Only and you entered the Unit ID of an installed WHP Controller, the following Status Screens are available.

Status Screen #1

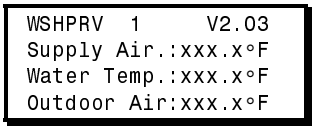


Line 2 - Current Zone Temperature

Line 3 - Current Cooling Setpoint (**CSP**) and Heating Setpoint (**HSP**)

Line 4 - Effect of optional *Sensor Slide Adjustment* on the current operating setpoints.

Status Screen #2

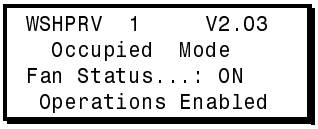


Line 2 - Current Supply Air Temperature

Line 3 - Current Leaving Water Temperature if Sensor is installed.

Line 4 - Current Outdoor Air Temperature.

Status Screen #3



Line 2 - Current Operating Status

Unoccupied Mode
Occupied Mode
Pushbutton Override
Forced Occupied
Forced Unoccupied
Forced Fan Only Mode

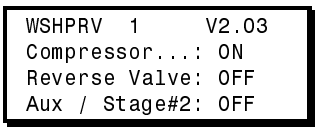
Line 3 - Current Fan Status

Fan Start Delay!
ON
OFF

Line 4 - Current Enable Status from Loop Controller

Operations Disabled
Operations Enabled

Status Screen #4

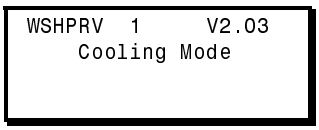


Line 2 - Current Compressor **ON/OFF** Status

Line 3 - Current Reversing Valve **ON/OFF** Status

Line 4 - Current Status of Relay #5. Operation depends on how the user configures this output.

Status Screen #5



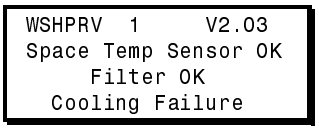
Line 2 - Current HVAC Operating Mode

Neutral Mode
Cooling Mode
Heating Mode

Line 3 - Reserved for future option.

Line 4 - Reserved for future option.

Status Screen #6



Line 2 -	**Bad Space Sensor**
	Hi Space Temp Alarm!
	Lo Space Temp Alarm!
	Space Temp Sensor OK
Line 3 -	**Dirty Filter Alarm**
	Filter OK
Line 4 -	**Cooling Failure!**
	Heating Failure!

Note: If no alarms exist, then the screen displays the message shown for No Alarms! If ANY alarm exists then the three lines display one of the messages shown above.

The **Cooling Failure** and **Heating Failure** alarms are generated as follows:

As the unit enters the cooling mode, the current Supply Air Temperature reading is stored in memory. After 10 minutes, if the temperature hasn't changed by 5°F a Cooling Failure alarm is generated.

A Heating Failure is generated in the same manner, only during the heating mode instead of the cooling mode.

The **Hi Space Temp** and **Lo Space Temp Alarms** are generated as follows:

If the space temperature gets 5°F above the cooling setpoint, a Hi Space Temp Alarm is generated. If the space temperature gets 5°F below the heating setpoint, a Lo Space Temp Alarm is generated.

View Alarms

Alarm Address Locations

```
SYSTEM ALARM STATUS
Alarm @ Unit ID  118
```

The System Manager can be programmed to poll all the units on your heat pump system for alarm information. This allows the centrally located System Manager to display an Alarm Indicator whenever an alarm condition exists anywhere on your system. The actual alarms are not displayed on this screen, only the Unit ID where the alarm is located. The example screen shows that a unit at location 118 has experienced an alarm condition. This alarm may or may not be current, as the System Manager latches the condition. This makes it possible to determine if any intermittent alarm conditions have occured. To find out what the alarm is, if it is still current, access the status screens for the Unit IDs that are displayed on the SYSTEM ALARM STATUS screens.

Alarm Clearing

```
SYSTEM ALARM STATUS
Clear Alarms?   YES
To Change Response
Use Left/Right Arrow
```

If all the alarm conditions have been corrected at the individual units, you can clear these alarms from the System Manager on the following screen. Use the Left/Right arrow keys to select the **YES/NO** response desired. If you clear the alarms, but some still exist, the System Manager will show an alarm indication, when the affected unit is polled again.

Menu Setpoints

Full Setpoint Access

```
1) Set Time & Date
2) Access Units
3) New Passcodes
4) Rebuild Alarm Map
```

If you selected the Menu key from the first menu screen you can access all setpoints available from any unit on your system. You must be a Level 2 user to access these setpoints. If you haven't already been asked to enter the passcode, you will be asked before the Full Setpoint Access menu is displayed. This prevents the casual user from being able to affect the operation of your heat pump system.

Set Time & Date

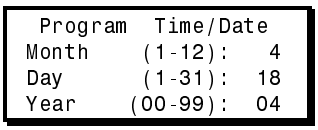
The System Manager has its own built in Real Time Clock. It broadcasts this time once a day, at midnight, to synchronize all of the WHPs on your system. Although the times are displayed on the Main Screen in a standard 12-hour format, they are programmed using the 24-hour Military format. Once the time has been entered, it is also broadcast immediately to all other units on the system. That means that you only need to program the System Manager time to set the Real Time Clocks for all units on your system. In order for the System Manager to broadcast the time and date to all controllers, they must be powered up and communicating.

Programming Time

```
 Program  Time/Date
Day   (Sunday=0):  1
Enter Hr. (0-23):  9
Enter Minutes   : 53
```

Day	-	Enter the Day of the Week (0 to 6) with Sunday = 0
Hours (Hr)	-	Enter Hours in 24-Hour Military Format (1700 = 5:00 PM)
Minutes	-	Enter the Minutes (0 to 59)

Programming Date



Month - Enter the Month (1 to 12)

Day - Enter the Day of the Month (1 to 31)

Year - Enter the current Year with 2 digits (00 to 99)

Daylight Savings Adjustments

If your area of the country requires Daylight Savings changes, you can enable the System Manager to automatically reset its own clock during the Daylight Savings changeover. If you enable this operation, it knows to changeover the first Sunday in April and then switch back the last Sunday in October. No other programming is required for this function.

Use the Left or Right arrow keys to toggle the second line of the display between **Adjustments Enabled** and **Adjustments Disabled**.

New Passcodes

Programming Passcodes

```
Enter New Passcode
Level 1....: XXXX
Level 2....: XXXX
[Must Be 4 Digits]
```

The System Manager has two levels of passcode.

Level 1 users are limited to viewing Setpoints and Alarms only.

Level 2 users have complete system access. Any status or setpoint field can be read or reset from WHP System Manager.

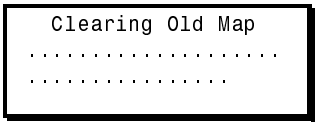
The default passcode is “1111” for level 1 and “2222” for level 2. If you need to change these defaults you can enter any 4 digit number between 1000 and 9999.

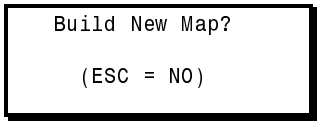
If you “forget” the passcode you programmed, you can still access the system with a built in backdoor code. This backdoor code is “9288” and is not programmable. It is not recommended that you give out this backdoor code since it would allow the user access without regard to the standard programmable passcode that most operators should be using.

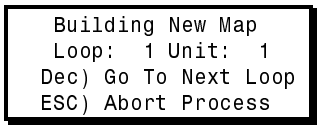
The actual digits in your passcodes are never displayed. An "X" is used as a place holder for each digit entered. Passcodes must *always* be four digits in length.

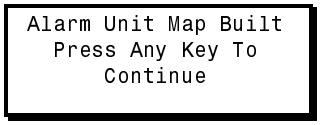
Rebuild Alarm Map

Rebuilding Screens









If you would like the LED Alarm Indicator to function on the front of your System Manager, you must enable Alarm Polling by building an Alarm Map. This map keeps track of which units exist on your communications loop so the System Manager will poll only those units. That means you will need to rebuild this map anytime units are added or removed from your system. It also means you can disable alarm polling. To do this, disconnect the RS-485 communications plug from the back of your Comm Link II. Then, select the Rebuild Alarm Map menu. The System Manager will not find any units to poll for alarms since none are connected. This is useful during building startup, when you don't want nuisance alarms bothering you.

The screen will display each address it is testing and if a unit is found at that address. If you don't want to wait for the System Manager to check for all 30 loops, you can press the ESC key as soon as the number of loops on your system are exceeded and the test will conclude. All units found up to that point will be saved in memory.

The System Manager does not rebuild this map automatically on powerup! You must do this manually. This rebuild need only be performed one time, when all units are up and running. It is not a regular requirement. As mentioned above, only when the number of units connected changes should the alarm map be rebuilt.

Heat Pump Setpoints

Heat Pump Setpoint Menu

```
1) WHP Setpoints
2) WHP Schedules
3) Reset Pumps
ESC)  To Exit
```

From the main menu screen select MENU on the keypad, select MENU again for Setpoints. Then select "Access Units" (keypad #2) and finally enter the loop and zone number for the desired unit.

As the screen above shows, there are three areas of programming available for each WHP Controller. Menu item #1 accesses all the standard temperature and configuration settings for the heat pump. Menu item #2 accesses the week schedule and holiday programming for the individual unit. Menu item #3 can be selected to force the heat pump to manually reset in the case of an operating problem.

1) WHP Setpoints

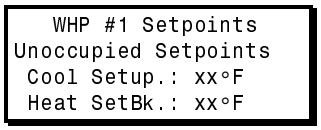
Setpoint Screen #1

```
 WHP #1  Setpoints
 Occupied Setpoints
Cooling Setpt: xx°F
Heating Setpt: xx°F
```

The Occupied **Heating** and **Cooling Setpoints** are programmed on this screen. The setpoints must be at least one degree apart. If you try to enter the same value or to cross the cooling and heating setpoints, the value you enter will not be accepted.

	Minimum	Default	Maximum
Cooling Setpt	50°F	74°F	90°F
Heating Setpt	50°F	72°F	90°F

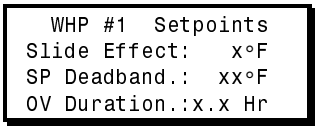
Setpoint Screen #2



The Unoccupied Heating and Cooling Setbacks are programmed on this screen. The **Cooling SetUp** is added to the Occupied Cooling Setpt to create the Unoccupied Cooling Setpoint. The **Heating SetBack** is added to the Occupied Heating Setpt to create the Unoccupied Heating Setpt.

	Minimum	Default	Maximum
Cool SetUp	1°F	10°F	30°F
Heat SetBack	-1°F	-10°F	-30°F

Setpoint Screen #3



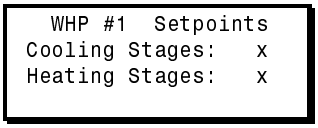
If the Space Temperature Sensor has the optional slide adjustment, then the **Slide Effect** is the maximum amount of change that it can have on the Heating and Cooling Setpoint and it is programmed here.

The **SP Deadband** is divided in half across the current heating and cooling setpoint, and is used in staging the heating and cooling on or off.

If you have an override pushbutton on the space sensor, the **OV Duration** is the length of time the unit will be in the occupied mode after pushing the button

	Minimum	Default	Maximum
Slide Effect	0°F	3°F	5°F
SP Deadband	0°F	1°F	20°F
OV Duration	0.0 Hr	1.0 Hr	8.0 Hr

Setpoint Screen #4



If the Heat Pump is configured to operate with a Reversing Valve, relay #5 can be configured as a second stage for either heating or cooling or both. If the Heat Pump is configured for individual heating and cooling, this determines how many of each stage there are.

	Minimum	Default	Maximum
Cooling Stages	0	1	2
Heating Stages	0	1	2

Setpoint Screen #5

```
  WHP #1  Setpoints
Min Run Time: x Min
Min Off Time: x Min
Min Cycle...:xx Min
```

The **Min Run Time** determines how long the compressor must remain on once it has been activated. The **Min Off Time** determines how long the compressor must remain off once it is de-activated. The **Min Cycle** time determines how many times per hour the compressor can be started. If you entered 10 minutes, the compressor could start a maximum of 6 times in a one hour period.

	Minimum	Default	Maximum
Min Run Time	0 Min	1 Min	20 Min
Min Off Time	0 Min	6 Min	20 Min
Min Cycle	0 Min	12 Min	60 Min

Setpoint Screen #6

```
   WHP #1 Setpoints
  Changeover Delay
 Between  Heat/Cool
Modes......:xx Min.
```

To prevent rapid cycling between heating and cooling modes, you can enter a time period that must be satisfied before the changeover can occur.

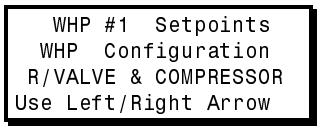
	Minimum	Default	Maximum
Changeover Delay	1 Min	30 Min	60 Min

Setpoint Screen #7

```
  WHP #1  Setpoints
Enable Signal Select
 NO ENABLE REQUIRED
Use Left/Right Arrow
```

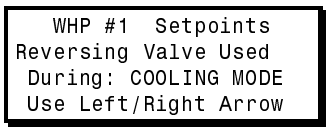
Normally you would want to have an Enable Signal that gave assurance of water flow before you activate the heat pumps compressor. If you need to operate without this enable signal, use the arrow keys to select the **NO ENABLE REQUIRED** message. Otherwise, select the **LOOP FLOW REQUIRED** message so that the signal must be present for the compressor to run.

Setpoint Screen #8



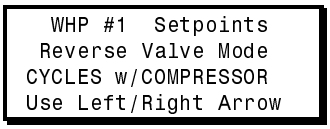
If your heat pump uses a reversing valve to determine the heating or cooling mode of operation, select the message **R/VALVE & COMPRESSOR**. If you are controlling separate stages of heating and cooling select the **INDIVIDUAL STAGING** message.

Setpoint Screen #9



If you have configured the system to use the reversing valve, you must select which mode requires it to be active. Select either the **COOLING MODE** or the **HEATING MODE** message.

Setpoint Screen #10



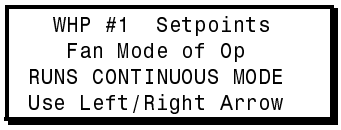
If you have configured the system to use the reversing valve, you can also set it to cycle on and off with the compressor, (**CYCLES w/COMPRESSOR**) or, to remain on once it is activated, and stay on until the opposite mode or unoccupied mode is selected (**RUNS CONTINUOUS MODE**). The valve always activates 10 seconds before the compressor starts no matter which method you select.

Setpoint Screen #11

If your system is configured to use the reversing valve and you only have one stage of heating and cooling, that last relay becomes available for other uses. The **AUXILIARY RELAY MODE** can be used to operate the relay manually from the Prism computer front end program. If you select **ISOLATION VALVE MODE**, the relay activates anytime the compressor is called for or whenever the Loop Controller sends an override command to activate and reduce loop pressure.

If the relay needs to follow an external week schedule, select the **AUXILIARY RELAY MODE** and then see the Aux Relay #5 Schedule assignment screen.

Setpoint Screen #12



You can program the fan to run continuously during the occupied mode, (**RUNS CONTINUOUS MODE**) or you can program it to cycle on and off with the compressor during both the occupied and the unoccupied mode of operation.
(**CYCLES W/COMPRESSOR**)

Setpoint Screen #13

If you configured relay #5 as an Auxiliary Relay, you can also program it to follow an external schedule command. You must have an ***OSS Optimal Start Scheduler*** installed somewhere on you communications loop to provide the external schedule you select here.

Setpoint Screen #14

```
 WHP #1  Setpoints
 Heat Pump Scheduling
Uses Schedule #:   x
0) Int.   1-7) Clock
```

The Heat Pump Controller can use the internal time clock for a setting an occupied schedule, for this the setpoint will be 0. It can also be programmed to follow an external schedule command. You must have an ***OSS Optimal Start Scheduler*** installed somewhere on you communications loop to provide the external schedule, and you select the schedule number here.

Setpoint Screen #15

```
   WHP  Setpoints
Startup Delay Period
  x Seconds Times
Board Address Switch
```

If you entered the same starting time for several heat pumps, they are prevented from all starting their fans at the same time by a Startup Delay Period that is determined by their address switch setting. The address is multiplied by the number of seconds you enter on this screen, up to a maximum of 60 seconds per address. This is the time period the fan must wait before it starts when the schedule goes occupied.

If you entered 5 seconds and the address was 10 then the fan would start 5 x 10 or 50 seconds after the schedule goes occupied.

Setpoint Screen #16

```
   WHP  Setpoints
Energy Demand Limits
  Max Effect:  xx°F
```

An Energy Demand Limit sequence is programmed into all heat pump controllers. *It is currently an option that is not supported* by a controller that can send the Demand Limit signal to initiate a limiting condition. *It is included here for future use only.*

	Minimum	Default	Maximum
Max Effect	0°F	3°F	30°F

Setpoint Screen #17

```
WHP # 1 Setpoints
  Heat Stage #2
SAT Lockout:  60°F
```

This setpoint is to shut the heating off when the supply air temperature is too warm. When the supply air temperature is above this setpoint, it will prevent the second stage of heat from coming on.

	Minimum	Default	Maximum
Max Effect	30°F	60°F	200°F

Setpoint Screen #18

```
SENSOR CALIBRATION
SPC  xxx.x°  xxxx.x°°
SAT  xxx.x°° xxxx.x°°
WAT  xxx.x°° xxxx.x°°
```

The ***Thermister Type III Sensor*** readings can be calibrated. Enter Positive values to increase the reading or Negative values to decrease the reading. If no sensor is attached, the calibration offset will still allow a value to be input and read for diagnostic purposes.

		Minimum	Default	Maximum
Space Sensor	SPC	-100.0°F	0.0°F	+100.0°F
Supply Air Sensor	SAT	-100.0°F	0.0°F	+100.0°F
Water Sensor	WAT	-100.0°F	0.0°F	+100.0°F

Setpoint Screen #19

```
WHP #1 Setpoints
Alarms: Enabled

Use Left/Right Arrow
```

Select if you want the notification LED on the front of the System manager to illuminate when an alarm occurs. If **Enabled** is selected, any WHP alarm will cause the Alarm LED on the front panel to light up. If **Disable** is selected, the Alarm LED will not light up but the alarm will still show up in the Status screen.

Note: You must do a Rebuild Alarm Map after all controllers are powered up and communicating.

2) WHP Schedules

The Water Source Heat Pump controllers contain their own built in scheduling capability for calculating Occupied/Unoccupied periods. Select item #2 from Schedules menu to access the following schedule programming menu.

Schedule Menu

```
   WSHP Schedules
1) Week Schedules
2) Holidays
MENU) Previous Menu
```

Week Schedule Programming

Event #1

```
  WEEK SCHEDULES
Sunday    Event #1
Start Time..:  xxxx
Stop  Time..:  xxxx
```

There are two Start / Stop events available per day.
The first line is the start time for event #1 and the next line is the stop time for event #1.

The screens will step through the ***Start Time*** and then the ***Stop Time*** for each day of the week. You can quit at any point in the process by pressing the "**ESC**" key.

Event #2

```
  WEEK SCHEDULES
Sunday    Event #2
Start Time..:  xxxx
Stop  Time..:  xxxx
```

If no second event is required, simply leave a ZERO for both the start and stop times on the event #2 screens.

All times are in 24-hour format, so 5:00 PM would be entered as 1700.

If both the Start and Stop Times are ZERO, the schedule is in a Continuous OFF mode.

If both the Start and Stop Times are 2359, the schedule is in a Continuous ON mode.

Holidays

Holiday Day Selection

There are 14 Holiday periods available, organized as a Start Day / Stop Day event. If the Holiday only lasts one day, enter the same date for the Start & Stop days. There is no limit to the duration or number of days that can be included in one holiday, other than it cannot extend past December 31st. If you have a holiday that crosses the end of year border, you will need to use two holiday periods to accomplish this event.

```
Program Holidays
Holiday #  1
Start Mon/Day: xxxx
(EX: 101 = Jan. 1)
```

The screens will step through the 14 possible ***holidays***, one at a time. Line 2 shows which holiday is currently being programmed.

```
Program Holidays
Holiday #  1
Stop  Mon/Day: xxxx
(EX: 102 = Jan. 2)
```

Line 3 shows which event, the Start Day or Stop Day, is currently being programmed.

Remember to combine the ***month and day*** into a single four digit value.

EXAMPLE: 0704 = July 4th

1225 = December 25th

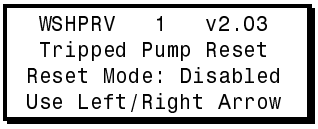
Holiday Start / Stop Times

```
WHP CONTROLLER
Holiday Schedule
Start Event #1..: xxxx
Stop  Event #1..: xxxx
```

The 14 holidays all use the same Holiday Start / Stop time. The start/stop times are programmed back on the Week Schedule screens. The holiday schedule screen appears after the Saturday schedule screen, as you are stepping through the days of the week.

Note: Normally there is no schedule in the Loop Controller device. It simply looks at all the Water Source Heat Pumps for a request to run signal. Scheduling is maintained separately in each Water Source Heat Pump. If you want to be able to schedule all Water Source Heat Pumps on and off at the same time, you can input a schedule on the Loop Controller and it will broadcast that schedule to all WHPs.

3) Reset Pumps



If one of your heat pumps has tripped off, it can be manually reset from the following screen. You will have entered the Unit ID to access the WHP Menu screen, so that is the unit that will receive this reset command. If you don't want to send the command, select the **Disabled** message with the arrow keys. If you do want to send the command, select the **Enabled** message with the arrow keys and then press the Enter button. This command will automatically clear itself when the WHP detects it and performs the reset.

There are two methods of resetting:

1. Relay #4, on the WHP will activate with the reset command and can be wired to provide the reset action.

2. The compressor relay will be cycled off. On newer heat pumps, this is all that is required to reset the operation.

Loop Controller Status

Loop Controller Status Menu

```
1) View Status Only
2) View Alarms
Menu) Setpoints
ESC)  To Exit
```

From the main menu screen select MENU on the keypad. Then select **"View Status Only"** (keypad #1) and finally enter the loop and zone number for the desired unit.

As the screen above shows, there are two areas of status available for the Loop Controller. Menu item #1 accesses all the status screens for the Loop Controller. Menu item #2 accesses the alarms for the Loop Controller. "Menu" can be selected to access the Setpoints screens.

Loop Controller Status Screens

If you selected menu item #1, View Status Only, and you entered the Unit ID of the Loop Controller, the following Status Screens are available.

Status Screen #1

```
  Loop Control v1.06
       OCCUPIED
Return Temp:   xx.x°F
Supply Temp:   xx.x°F
```

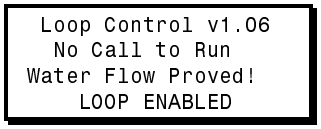
Line 2 - Current operating Mode:

OCCUPIED
UNOCCUPIED

Line 3 - Current Return Water Temperature

Line 4 - Current Supply Water Temperature

Status Screen #2



Line 2 - Current operating Mode:

No Call To Run
ACTIVE CALL TO RUN

FREEZE PROTECTION!

Line 3 - Current Water Flow Status:

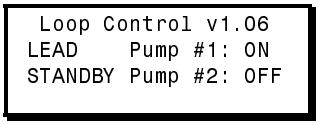
Water Flow Proved!

No Flow Detected

Line 4 - Current Request to Operate Status:

LOOP ENABLED
LOOP DISABLED

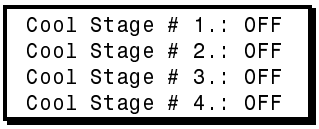
Status Screen #3



Line 2 - LEAD Pump #1 **On or Off**

Line 3 - STANDBY Pump #2 **On or Off**

Status Screen #4



Line 1 - Cool/Heat Stage #1 **On/Off**

Line 2 - Cool/Heat Stage #2 **On/Off**

Line 3 - Cool/Heat Stage #3 **On/Off**

Line 4 - Cool /Heat Stage #4 **On/Off**

Status Screen #5

```
Cool Stage # 5.: OFF
Cool Stage # 6.: OFF
Cool Stage # 7.: OFF
Cool Stage # 8.: OFF
```

Line 1 - Cool/Heat Stage #5 **On/Off**

Line 2 - Cool/Heat Stage #6 **On/Off**

Line 3 - Cool/Heat Stage #7 **On/Off**

Line 4 - Cool/Heat Stage #8 **On/Off**

Status Screen #6

```
 Loop Control v1.06
Pressure.: xxx.x PSI
Pump VFD.:  xx.x VDC
Heat VFD.:  xx.x VDC
```

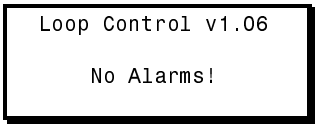
Line 2 - Current Loop Water Pressure

Line 3 - Current Variable Speed Pump Voltage Signal

Line 4 - Current Proportional Heat Voltage Signal

Note: If none of the above options have been configured, then the values in this status screen will be 0.

Status Screen #7



Line 2 - **Pump Failure** *or* Blank Line

Line 3 - **Hi Control Water Temp**

Lo Control Water Temp

Line 4 - **Fire/Smoke Alarm**

Phase Shutdown

Note: If no alarms exist, then the screen displays the message shown for No Alarms! If ANY alarm exists, then the three lines display one of the messages shown above.

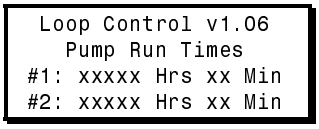
The **Fire/Smoke Alarm** is generated as follows:

If the NC (normally closed) contact from a firestat or smoke detector that is wired between GND and AIN1, on the Analog Input expansion board, opens, the Fire/Smoke Alarm is generated.

The **Phase Shutdown Alarm** is generated as follows:

If the NO (normally open) contact from a phase monitoring device, that is wired between GND and AIN7 is made, the Phase Shutdown Alarm is generated.

Status Screen #8



Line 2 - Message Only

Line 3 - Pump #1 Hours and Minutes Run Time

Line 4 - Pump #2 Hours and Minutes Run Time

Loop Controller Setpoints

Loop Controller Setpoint Menu

```
1)  LC Setpoints
2)  LC Schedules
3)  LC Force Modes
ESC)  To Exit
```

Setpoint Screen #1

```
  WHP Loop Setpoints
    HEAT REJECTION
 Setpoint......: xx°F
 Stage Deadband: xx°F
```

If the controlling water temperature rises above this **Setpoint**, the Heat Rejection or Cooling Stages begin to stage on. As the temperature continues to rise above the Setpoint by the Deadband amount, an additional stage is added. Each additional stage can only activate if the temperature rises above the Setpoint by the number of active stages times the deadband value.

Example: There are 2 stages on, a 3° deadband and the setpoint is 79°
2 x 3° + 79° = 85° before stage 3 can activate

	Minimum	Default	Maximum
Setpoint	50°F	79°F	99°F
Stage Deadband	1°F	3°F	10°F

Setpoint Screen #2

```
  WHP Loop Setpoints
    HEAT REJECTION
 Stage Delay...: x M
```

The Staging Delay period must also be satisfied before an additional stage of cooling or heat rejection can be activated. The maximum number of heat rejection stages are programmed on this screen also.

	Minimum	Default	Maximum
Stage Delay	1 Minute	1 Minute	60 Minutes

Setpoint Screen #3

```
WHP Loop Setpoints
  HEATING ADDITION
Setpoint......: xx°F
Stage Deadband: xx°F
```

If the controlling water temperature drops below this Setpoint, the Heat Addition or Boilers begin to stage on. As the temperature continues to drop below the Setpoint by the Deadband amount, an additional stage is added. Each additional stage can only activate if the temperature drops below the Setpoint by the number of active stages times the deadband value.

Example: There are 2 stages on, a 3° deadband and the setpoint is 79°
79° - 2 x 3° = 73° before stage 3 can activate

	Minimum	Default	Maximum
Setpoint	50°F	76°F	99°F
Stage Deadband	1°F	3°F	10°F

Setpoint Screen #4

```
WHP Loop Setpoints
  HEATING ADDITION
Stage Delay...:  x M
```

The Staging Delay period must also be satisfied before an additional boiler or heat addition stage can be activated.
The maximum number of heat addition stages are programmed on this screen also.

	Minimum	Default	Maximum
Stage Delay	1 Minute	1 Minute	60 Minutes

Setpoint Screen #5

```
WHP Loop Setpoints
OA FREEZE PROTECTION
Setpoint.....:  xx°F
```

If the outdoor air temperature drops below this setpoint, the pump will be energized to prevent the water lines from freezing.

	Minimum	Default	Maximum
Setpoint	-50°F	40°F	50°F

Setpoint Screen #6

```
WHP Loop Setpoints
Water Hi Limit:  xx°
Water Lo Limit:  xx°
Alarm Delay...:   xM
```

If the controlling water temperature rises above the **Water Hi Limit** setpoint, all heat addition will be removed and one stage of heat rejection will be activated. If the controlling water temperature drops below the **Water Lo Limit** setpoint, all heat rejection stages will be removed and one heat addition stage will be activated. An alarm will be generated if it remains out of limits for the **Alarm Delay** Time.

	Minimum	Default	Maximum
Water Hi Limit	0°F	120°F	120°F
Water Lo Limit	0°F	0°F	120°F
Alarm Delay	0 Min	30 Min	120 Min

Setpoint Screen #7

```
WHP Loop Setpoints
Pump Speed: CONSTANT
Flow Proof: CONTACT
Use Left/Right Arrow
```

The Loop Controller can modulate a Variable Speed Pump. Select the **PRESSURE** option in place of the **CONSTANT** option for variable speed pumping.

The water flow proving can be accomplished by a differential pressure contact closure or an actual pressure sensor. If you select Variable Speed Pumping, you *must* select the **PRESSURE** option in place of the **CONTACT** option for Flow Proof.

Setpoint Screen #8

```
WHP Loop Setpoints
STEP HEATING CONTROL
RETURN WATER CONTROL
Use Left/Right Arrow
```

There are two methods of Heat Addition control, **STEP HEATING CONTROL** or **PROPORTIONAL HEATING** The Loop Controller can be configured to maintain Return Water Temperature (**RETURN WATER CONTROL**) or the Supply Water Temperature (**SUPPLY WATER CONTROL**)

Setpoint Screen #9

```
WHP Loop Setpoints
Lead/Lag  Changeover
Switch After xxx Hrs
```

The two pumps will switch after this programmed amount of time so that each pump accumulates roughly the same number of run time hours. If a pump is currently running and this time period is exceeded, the changeover will occur as soon as pump run time exceeds the setpoint. The current pump will shut off and the standby pump will start at the same time.

	Minimum	Default	Maximum
Changeover	1 Hour	40 Hours	240 Hours

Setpoint Screen #10

```
WHP Loop Setpoints
Water Loop Proof Of
Flow Pr. SP: xxx PSI
```

If you attached a Pressure Sensor for proof of flow instead of a differential pressure contact closure for proof of flow, the controlling pressure is programmed on this screen. This Setpoint represents the amount of pressure that you set to prove water flow exists in the system. Otherwise, this screen will not appear.

	Minimum	Default	Maximum
Flow PR. SP	0	5 PSI	50 PSI

Setpoint Screen #11

```
WHP Loop Setpoints
Pressure SP: xxx PSI
SP Deadband:  xx PSI
Adjust Time: x.x Sec
```

If you configured the system for Variable Speed Pumping with a Pressure Sensor for proof of flow, the controlling pressure, deadband and control adjust time period are programmed on this screen. Otherwise, this screen will not appear.

	Minimum	Default	Maximum
Pressure SP	1 PSI	40 PSI	50 PSI
SP Deadband	1 PSI	2 PSI	50 PSI
Adjust Time	0.1 Seconds	1.0 Seconds	25 Seconds

Setpoint Screen #12

```
WHP Loop Setpoints
Isolation Valves Set
Open if PSI is Above
Hi Limit...: xxx PSI
```

If you configured the system for Variable Speed Pumping with a Pressure Sensor for proof of flow, the Loop Controller can send a signal to all the Heat Pumps to open their Isolation Valves whenever a Hi Limit Pressure is exceeded. If the Heat Pumps do not control an Isolation Valve, then the only reaction is to reduce the variable speed pump voltage signal.

	Minimum	Default	Maximum
Hi Limit	1 PSI	50 PSI	50 PSI

Setpoint Screens #13

```
SENSOR CALIBRATION
RWT  xxx.x°  xxxx.x°°
SWT  xxx.x°° xxxx.x°°
OAT  xxx.x°° xxxx.x°°
```

The ***Thermister Type III Sensor*** readings can be calibrated. Enter a Positive value to increase the reading or a Negative value to decrease the reading. If no sensor is attached, the calibration offset will still allow a value to be input and read for diagnostic purposes.

		Minimum	Default	Maximum
Return Water	RWT	-10.0°F	0.0°F	+10.0°F
Supply Water	SWT	-10.0°F	0.0°F	+10.0°F
Outdoor Air	OAT	-10.0°F	0.0°F	+10.0°F

Note: Due to memory limitations in the Loop Controller, the maximum amount of calibration offset is 10.0°F.

Setpoint Screen #14

```
WHP Loop Setpoints
 Alarms: Enabled

Use Left/Right Arrow
```

Alarms can be configured to light the LED on the front of the System Manager by setting Alarms to **Enabled**, if you do not wish to report alarms, select **Disabled**.

Setpoint Screen #15

```
WHP Loop Setpoints
Relay Configurations
Rly  1:  ADDITION
Use Left/Right Arrow
```

Use this screen to configure the relays on the expansion board for heat **ADDITION, REJECTION** or **NOT USED**. All 8 relays come up one at a time.

Notes:

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Start-Up and Troubleshooting

1.0 Communications Overview

Perhaps no other portion of the system seems as difficult to diagnose as the communications loop, yet it really can be quite simple if you understand how it works. In fact, much of the troubleshooting can be done by simple observation. We will lead you through the system functions and then provide you with detailed instructions for checking each piece of equipment.

1.1 How It Works

WattMaster uses a token-passing loop architecture, which means in simple terms that an "electronic message" called a ***token*** is passed from controller to controller in a round-robin fashion. A controller must wait to receive the token before it can ***send*** or ***request*** any data.

Note: It is **very important** to know which device is the loop master on the loop you are troubleshooting.

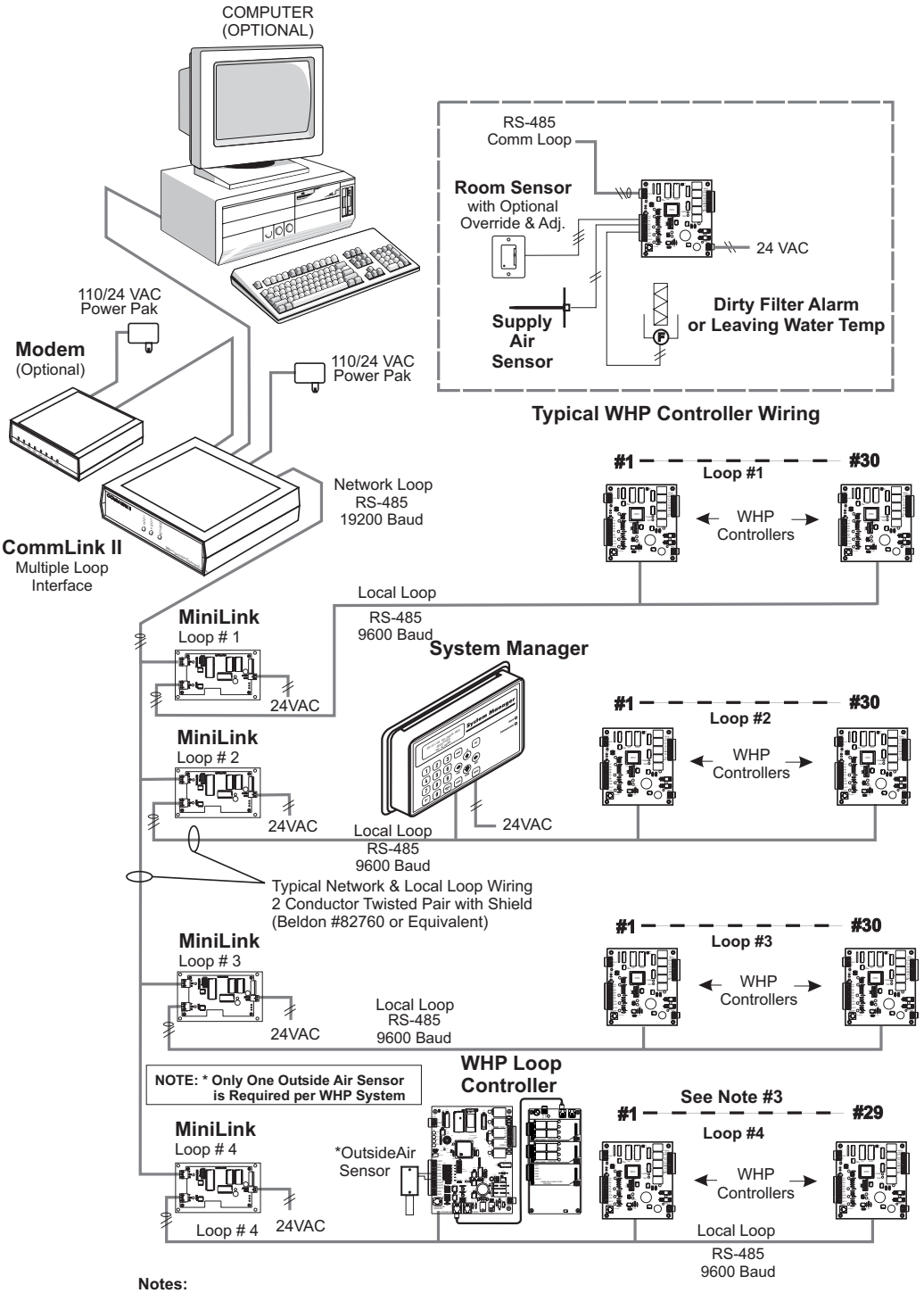
1.2 WattMaster WHP System

The standard WattMaster WHP system may have only one communications loop or as many as thirty communication loops depending on the number of WHP Controllers to be connected to the system. It is important to remember that each loop must have its own master.

If you are using the multiple loop version of the WHP system (for systems with more than 30 WHP Controllers) a loop is required for each group of 30 WHP Controllers. The WHP Loop Controller may be connected to any of the Local Loops. The Local Loop that has the WHP Loop Controller installed can only have 29 WHP Controllers on that loop. Each Local Loop is connected to a MiniLink loop interface. The ***MiniLink is always the master on the Local Loops***. The MiniLinks are connected to the CommLink II and to each other via the Network Loop.

The ***CommLink II is always the master on the Network Loop***. You must be sure the CommLink II is connected and functioning if you are troubleshooting the communications loops. Make sure the CommLink II is set for multiple loops

.



Notes:

1.) 24 VAC Must Be Connected So That All Ground Wires Remain Common.

2.) All Wiring To Be In Accordance With Local And National Electrical Codes and Specifications.

3.) The Local Loop With The Loop Controller Installed Can Only Have Up To 29 WHP Controllers Attached As The WHP Loop Controller Occupies Address #30.

4.) Systems may consist of up to 20 Local Loops (600 WHP Controllers). Consult factory for systems that exceed these quantities.

Figure 4-1: System Wiring Overview

All communications wiring should be labeled to avoid confusion and to aid future servicing.

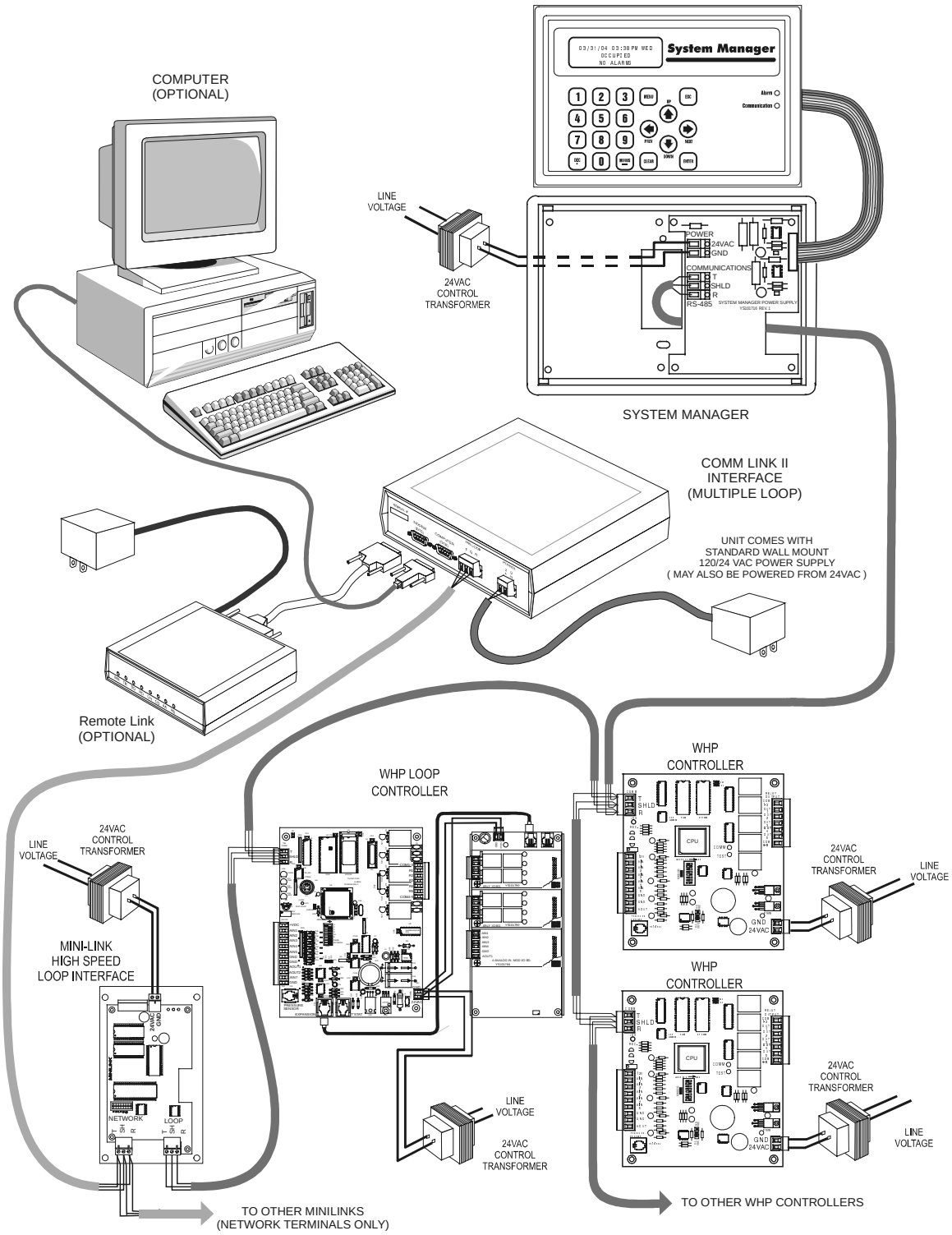


Figure 4-2: Communications Loop Routing

2.0 WHP Controller Overview

2.1 How It Works

2.1.1 Initialization

On system powerup the COMM LED remains extinguished for five seconds. After this delay, the COMM LED will blink out the address of the controller (Address Switch Setting). The COMM LED will then extinguish for another five seconds and then begin to blink for a twenty second startup delay. At the conclusion of this twenty second period, the COMM LED will begin blinking a diagnostic code every ten seconds. This code is described later in this document. The duration of a powerup initialization sequence is roughly one minute.

During this initialization period, the controller retrieves all operating setpoints from its non-volatile EEPROM memory and initializes all outputs to an OFF condition.

Note: All future references to the Water Source Heat Pump Controller in this document use WHP as the designation.

2.1.2 Operating Summary

At all times, after the conclusion of the initialization sequence, the WHP performs a specific set of operating instructions in the following order: (a - g repeat continuously)

a. Read Analog Inputs for Temperatures and Overrides.
b. Check the RS-485 communications port for any new setpoints from the System Manager and keeps the status updated for the System Manager.
c. If the push-button override is active, it checks the timer to see if the override is finished.
d. Calculates the current occupied/unoccupied mode from its internal week scheduling.
e. Calculates what state the output relays and analog output should be set to.
f. Updates the diagnostic COMM LED blinking.
g. Stores data in the internal trend log if ready for another log.

2.2 Becoming Familiar with the WHP Controller

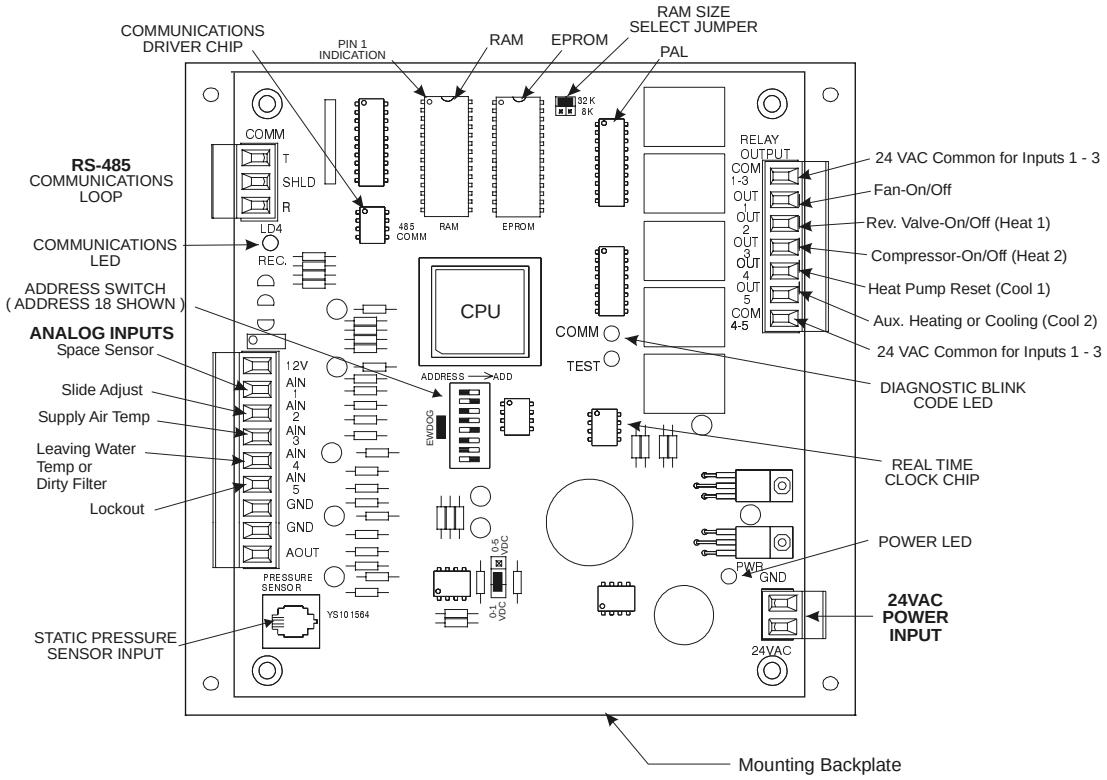


Figure 4-3: WHP Controller Component Layout

2.2.1 24 VAC Power Connector

This connector provides power to the WHP Controller.

24VAC - The "hot" side of the control transformer.

GND - The grounded side of the control transformer. If the secondary of the control transformer is not grounded, ***you must still observe polarity if the transformer powers any other device!***

Warning: Connect only the GND terminal to the grounded side of a transformer - **Failure to properly observe polarity will result in damage to the system.** Observe polarity at all points in the system.

2.2.2 Analog Inputs

This connector carries the analog and binary control input signals.

AIN1 - Space Temp - This input accepts a two wire 10K Type III thermistor temperature sensor. The sensor measures 10,000 Ohms @ 77°F. The resistance drops as the temperature increases. The sensor is connected between this terminal and the GND terminal. This input is also monitored for push-button override commands. The push-button is only active during unoccupied hours so a push during occupied hours has no effect.

AIN2 - Slide Adjust - If the OE212 or OE213 space temperature sensor is installed, the sensor contains a slide adjust control for varying the current heating and cooling setpoints. If the OE210 or OE211 sensors are used, this input will not be used.

AIN3 - Discharge Temp - The discharge temperature reading is used to detect discharge air temperature and to monitor for equipment failure. Once the compressor has activated, the discharge air temperature has 10 minutes to change by 5°F or the controller assumes a mechanical failure has occurred.

AIN4 - Leaving Water Temp and/or Dirty Filter Alarm - Can provide status only water temperature and/or dirty filter contact closure. If both are used at the same time, water temperature will be lost when the dirty filter contact is closed.

AIN5 - Lockout - If this input is active all operations are terminated to protect the equipment.

GND - Common return wire. This point is tied to ground on the WHP Controller.

2.2.3 Analog Output Description

AOUT - Analog Output - This output is not used.

2.2.4 Relay Output Descriptions

COM1-3 - Common 1 thru 3. - This ties the common return of the first 3 outputs together.

OUT1 - Fan On/Off - The fan is enabled to run when this contact is closed.

OUT2 - Reversing Valve or Heat 1 - This output enables the reversing valve if you have configured the WHP Controller for a compressor and reversing valve configuration. If the WHP Controller is configured for individual staging of heating and cooling (no reversing valve) then this output enables heating stage 1.

OUT3 - Compressor or Heat 2 - This output enables the compressor if you have configured the WHP Controller for a compressor and reversing valve configuration. If the WHP Controller is configured for individual staging of heating and cooling (no reversing valve) then this output enables heating stage 2.

OUT4 - Heat Pump Reset or Cool 1 - This output can be used to reset a compressor that has gone off line. If the WHP Controller is configured for individual staging of heating and cooling (no reversing valve) then this output enables cooling stage 1.

OUT5 - Aux. Relay or Cool 2 - If you have configured the WHP Controller for a compressor and reversing valve configuration this output can be configured as follows:

1.) Stage 2 for cooling and/or heating mode.
2.) Auxiliary scheduling relay. In this mode it can be programmed to follow an externally broadcast schedule signal.
3.) Auxiliary relay. In this mode it can be used for any function requiring a manual user intervention.
4.) Isolation valve. May be used to initiate opening of an isolation valve in case of high loop water pressure even if the WHP Controller is satisfied or in an unoccupied mode. In occupied mode this relay operates in conjunction with the compressor.

If the WHP Controller is configured for individual staging of heating and cooling (no reversing valve) then this output enables cooling stage 2.

COM4-5 - Common 4 and 5. - This ties the common return of the last 2 outputs together. Jumper this terminal to COM1-3 if the unit does not have separate cooling and heating power supplies.

2.2.5 RS-485 Communications Connector

This connector provides the connection point for the Local Loop RS-485 communications loop. The wiring consists of a twisted pair of wires with a shield.

T - RS-485 (+) Communications terminal

SHLD - Common return wire, this point is internally tied to GND on the WHP Controller.

R - RS-485 (-) Communications terminal

2.2.6 WHP Controller Wiring

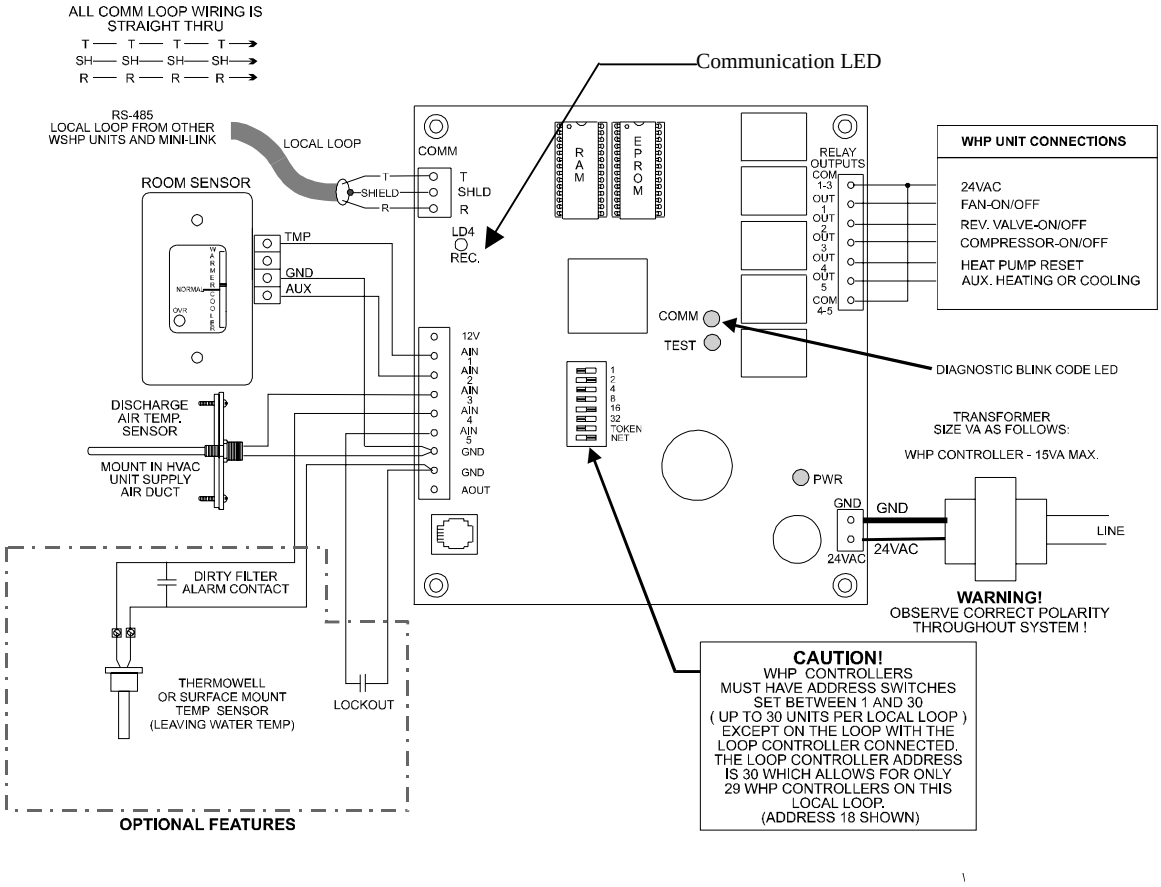


Figure 4-4: Typical WHP Controller Wiring Diagram

3.0 Loop Controller Overview

3.1 How It Works

3.1.1 Initialization

On system powerup LED2 remains extinguished for five seconds. After this delay, the LED2 will blink out the address of the controller (Address Switch Setting). The LED2 will then extinguish for another five seconds and then the LED2 will begin blinking a diagnostic code every ten seconds. This code is described in the troubleshooting section. The duration of a powerup initialization sequence is roughly thirty seconds.

During this initialization period, the controller retrieves all operating setpoints from its non-volatile EEPROM memory and initializes all outputs to an OFF condition.

3.1.2 Operating Summary

There is a standard set of operating instructions that are continuously performed over and over during normal Loop Controller operations. They are listed below.

a Read analog inputs for temperatures, pressures and binary contact closures

b Checks for new setpoints from System Manager or Prism Software and keeps the status values updated for these interfaces.

c Looks for "request to run" broadcast from any installed WHP Controller or from an on-board binary input.

d. Set all outputs to match calculations for heat rejection or addition.

e. Store data in internal trend log if ready for another log

f. Broadcasts the operating commands to all WHP Controllers.

g. Tests for lead/lag pump changeover if both pumps are off.

h. Repeat steps a-g continuously

3.2 Loop Controller Inputs & Outputs

3.2.1 Analog Inputs

AIN1 - Return Water Temp - This input accepts a two wire 10K Type III thermistor temperature sensor. The sensor measures 10,000 Ohms @ 77°F. The resistance drops as the temperature increases. The sensor is connected between this terminal and the GND terminal.

AIN2 - Supply Water Temp - This input accepts a two wire 10K Type III thermistor temperature sensor. The sensor measures 10,000 Ohms @ 77°F. The resistance drops as the temperature increases. The sensor is connected between this terminal and the GND terminal.

AIN3 – Proof of Flow/Loop Pressure - This input accepts a differential pressure contact closure for proof of flow or a 0-50 PSI (0-5VDC) pressure transducer signal.

AIN4 - Outdoor Air Temp - The OA temperature is used to determine if pumps should be turned on during off periods, to prevent freezing. When the OA temperature is below 40° F, the pumps will be turned on.

AIN5 - Manual Reset Input - Used to restart equipment after alarm condition has occurred. When this input is shorted to GND by a momentary pushbutton, a signal to restart is sent.

AIN7 – **Phase Loss –** If a phase monitor is being used, a normally open contact is connected here. When a loss of phase is detected, this contact closes shutting down the Loop Controller.

GND - Common return wire. This point is tied to ground on the Loop Controller.

3.2.2 Analog Output

This connector carries a 0-10 volt control signal for the following items:

AOUT1- **Pump VFD Signal** - If you have selected the variable speed pump option this output signal is used to control the loop pressure.

AOUT2 - **Proportional Heat Signal** - This output may be used when a modulating signal is required to control heat addition temperature.

GND - Common return wire, this point is tied to GND on the Loop Controller.

3.2.3 Binary Output

R1 – **Compressor Enable** – Energizes the first stage of cooling.

R2 – **Main Pump** – Energizes the lead water pump.

R3 – **Standby Pump** – Energizes the standby pump if the main pump fails to start.

R4 – **Alarm Indicator** – Energizes when an alarm occurs on the Loop Controller.

R5 – **Not Used** – This output is not used.

COM 1-3 - Common – 24 VAC from the AHU is connected to this terminal and is the common for inputs 1 through 3.

COM 4-5 - Common – 24 VAC from the AHU is connected to this terminal and is the common for inputs 4 and 5.

3.2.4 Relay Expansion Board - Outputs

This connector carries the output relay dry contact open/closed signal.

Relays 1-4 - Heat Addition/Rejection Stages - Can be configured to be used for either stages of heating or cooling of water when required.

Relays 5-8 - Heat Addition/Rejection Stages – Same as above, can be used for heating or cooling of the water.

3.2.5 Analog Input Expansion Board

The following inputs use dry contact open/closed signals.

AIN1 – Fire Alarm Contact - Used to shut down all equipment in case of a smoke or fire condition.

AIN2 - Request to Run - Used to initiate system start when a water source heat pump controller other than the WattMaster WHP Controller is used.

Warning: **Fire Alarm Contact** input must be connected to the AIN1- GND terminal if it is not used, a jumper must be connected between AIN1 and GND, since this is a normally closed contact input. ***If this is not done the system will not operate.***

3.2.6 Comm Connector - Communications

RS-485 Communications Connector - This connector provides the connection point for the Local Loop RS-485 communications loop. The wiring consists of a twisted pair of wires with a shield.

T - RS-485 (+) Communications terminal

SHLD - Common return wire, this point is internally tied to GND on the WHP Controller.

R - RS-485 (-) Communications terminal

3.2.7 Power Terminal

This connector provides power to the Loop Controller

24 VAC - Connect to the "HOT" side of the control transformer.

GND - The grounded side of the control transformer. If the secondary of the control transformer is not grounded, ***you must still observe polarity if the transformer powers any other device!***

Warning: Connect only the GND terminal to the grounded side of a transformer ***Failure to properly observe polarity will result in damage to the system.*** Observe polarity at all points in the system.

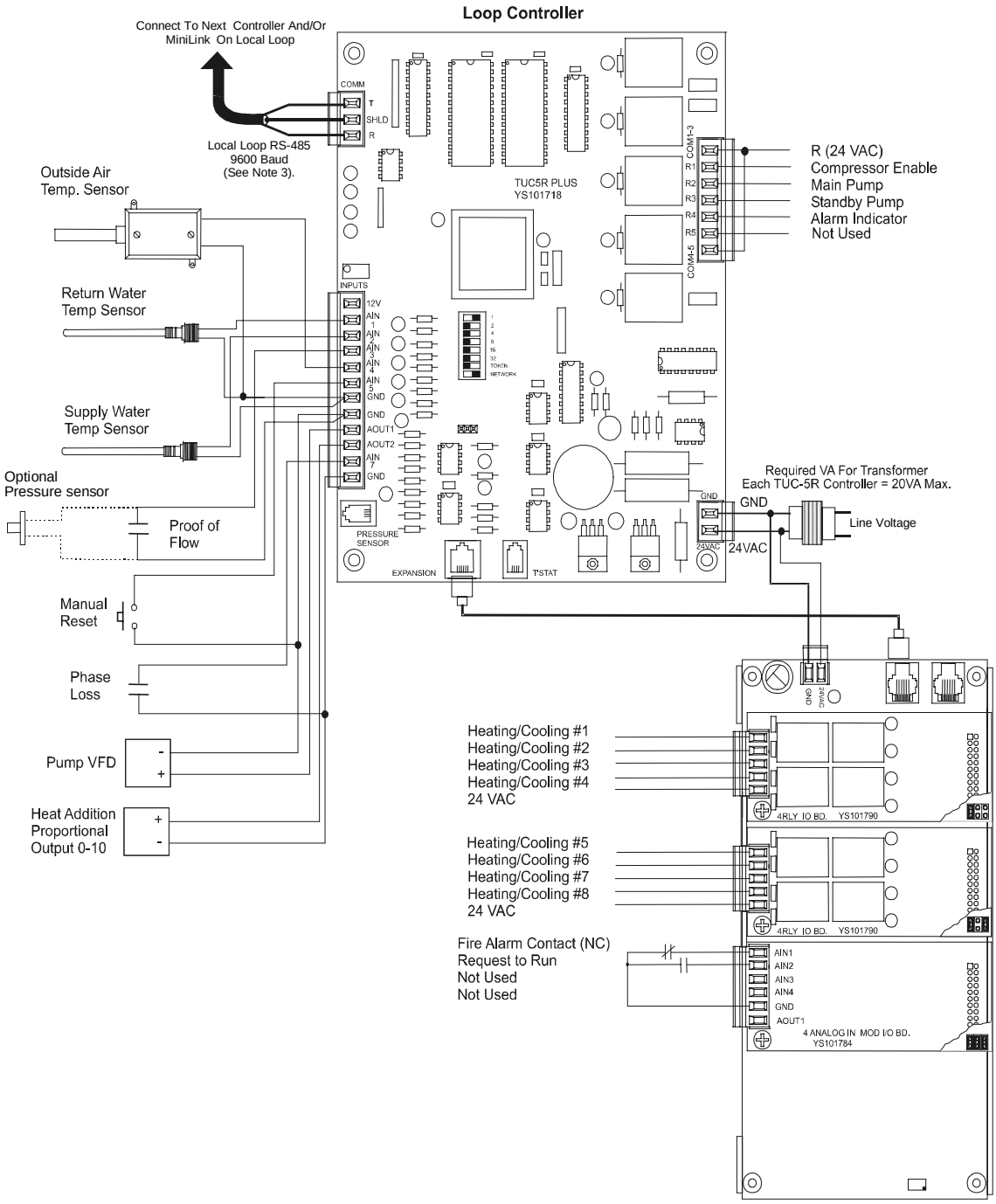


Figure 4-5: Loop Controller Inputs & Outputs

4.0 Start-Up

4.1 Blink Codes for WHP Controllers

The WHP Controller uses an on board LED to indicate various diagnostic conditions during powerup and operation. The WHP Unit LED is labeled "COMM". Starting with power up the LED blink codes are as follows:

- Off for five seconds
- COMM LED blinks the board address (Address 14 = 14 blinks)
- Five second pause
- Twenty second time delay - LED blinks twenty times
- Status code is repeatedly blinked every ten seconds to indicate controller status:

Priority	No. of Blinks	Status
Lowest	1	Normal Operation
-	2	Override Active
-	3	Bad Space Sensor
-	4	Heat Pump Lockout
Highest	5	Communication Failure

Figure 4-6: Diagnostic LED Blink Codes

Only the highest priority failure code will be shown. You must correct the highest priority alarm before other problems will be indicated.

4.2 Blink Codes for Loop Controllers

The Loop Controller uses an on board LED to indicate various diagnostic conditions during powerup and operation. The Loop Controller Unit LED is labeled "LED2". Starting with power up the LED blink codes are as follows:

- Off for five seconds
- COMM LED blinks the board address (Address 14 = 14 blinks)
- Five second pause
- Status code is repeatedly blinked every ten seconds to indicate controller status:

Priority	No. of Blinks	Status
Lowest	1	Normal Operation
-	2	Pump and/or Flow Failure
-	3	Bad Water Temp Sensor
-	4	Single Phase Shutdown
-	5	Water Pressure Alarm
Highest	6	Fire Alarm

Figure 4-7: Diagnostic LED Blink Codes

Only the highest priority failure code will be shown. You must correct the highest priority alarm before other problems will be indicated.

4.3 Communications Checklist

- WHP Controllers are addressed from 1 to 30 on each loop except the loop with the WHP Loop Controller. This loop can only use address 1 thru 29 for the WHP Controllers. WHP Loop Controller is addressed as 30 on the loop it is connected to.
- Power has been cycled after changing addresses
- A multiple loop CommLink II is powered and connected to the communications loop.
- System Manager is connected to one of the local loops.
- The MiniLinks on each local loop are addressed with a unique address 1 thru 30, depending on the number of loops on your system.

4.4 Installation and Commissioning Information

Familiarize yourself with the installation manual and system wiring diagrams before installing!

1. Check to see if you have all the correct components for your installation.

2. Establish the location for the CommLink Interface first. This is where your communication cable will begin.

3. Layout your communication wiring. For systems with more than 30 WHPs or more than one MiniLink, there are multiple communication loops:

   A. The Network Loop - This loop originates at the CommLink and interconnects MiniLinks together.

   B. The Local Loop – This loop originates at the MiniLink. The WHPs, Loop Controllers and the System Manager are connected to this loop.

Tip: Using the WattMaster color-coded and labeled Communication Cable insures a quality installation. It also makes your installation much easier and less likely to have communications wiring errors!

4. **Communication cable must always be shielded – no exceptions!**

5. Mount controllers in appropriate locations according to their operating specification.

6. Address controllers according to location and addressing instructions located in the system manual.

7. With no power connected, wire controller according to wiring diagrams and in accordance with local codes. Never apply power until you have completed these procedures in accordance to all system instructions.

8. After completing all wiring connections, unplug the terminals for power and communications. Always unplug the communications loop first and then the power. When reconnecting the wiring, connect the power first and then the communication loop.

9. Continue step 8 until all devices have been wired and the power and communication terminals have been unplugged.

10. Install CommLink and power-up. At this point you are ready to begin commissioning the system. It is preferred, though not necessary, to use a PC with Prism software to assist in the commissioning process.

11. Start with the first controller on the communication loop or in multiple loop systems; start with the MiniLink or with the System Manager. Plug in the Communication terminal then plug in the Power terminal.

12. Observe the LED indicator for the blink codes as outlined in the troubleshooting section of the manual. The blink code will first verify the address, then the operation. If the address is incorrect, reset the dipswitch, then reapply power to the controller.

13. After each controller is connected and completes its initialization sequence, use the PC or System Manager to verify communication to that device. If you cannot communicate, verify wiring, voltages, etc. in accordance with the troubleshooting section in the system manual. Do not proceed to the next device until you are properly communicating with the current device.

Continue this process until all controllers are connected and properly communicating.

By following the above steps and procedures, your installation will be much faster and trouble free. Remember that each controller only contains one puff of smoke. Making sure that all wiring terminations and voltages are correct prior to applying power to a controller will insure that you don't use that one puff.

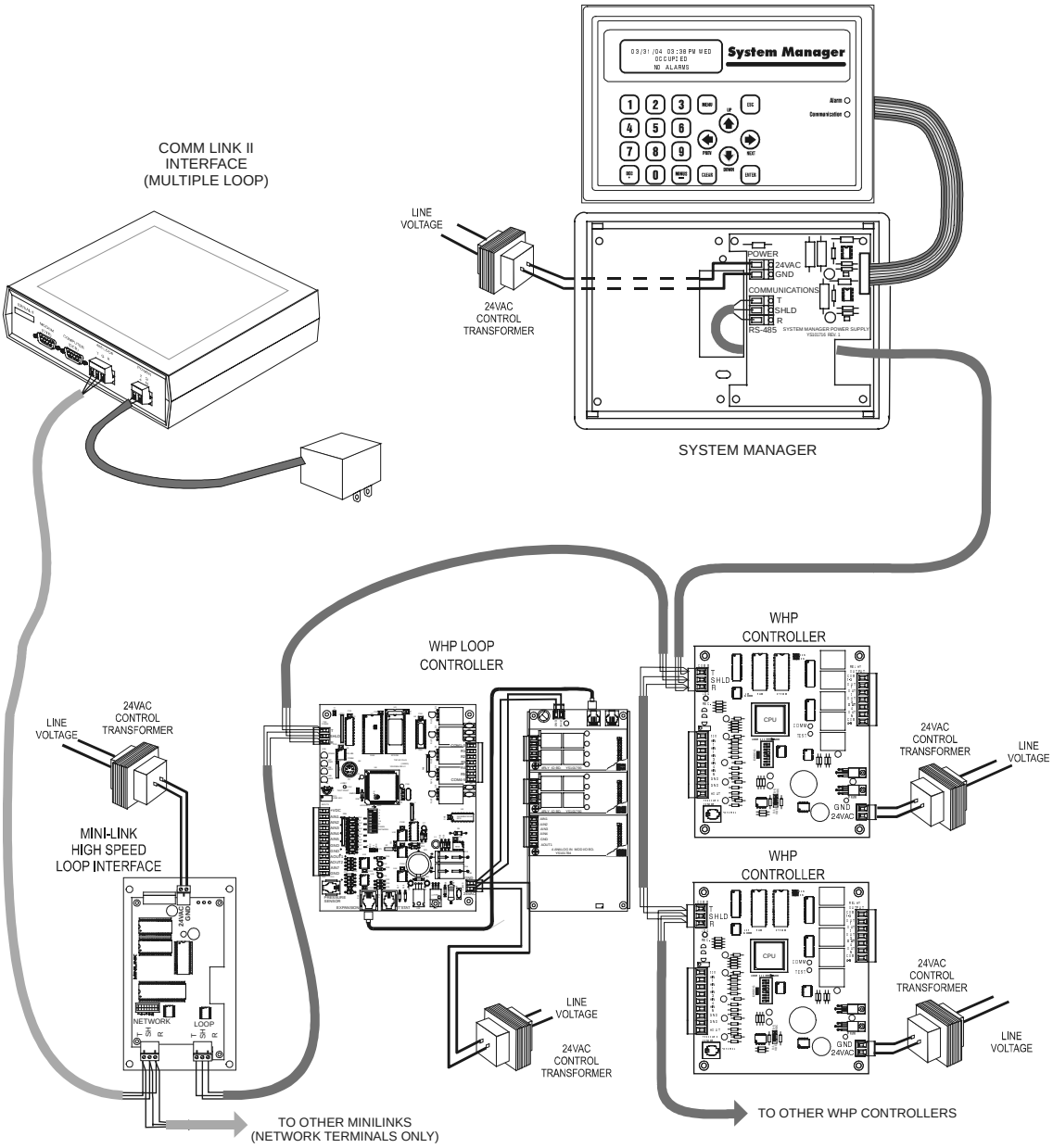


Figure 4-8: Communications Loop Wiring

4.5 Setting Address Switches

4.5.1 Setting the MiniLink Address Switch

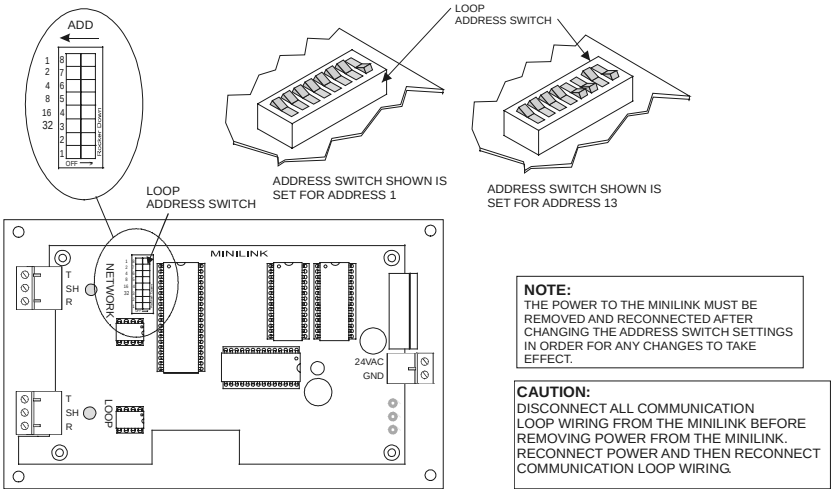


Figure 4-9: MiniLink Address Switch Setting

4.5.2 Loop Controller Addressing

The Loop Controller address should always be set for address #30. A maximum of 29 WHP Controllers on the loop that contains the Loop Controller. All other loops may have 30 WHP Controllers. (Refer to **Figure 2-10** for more detail)

4.5.3 WHP Controller Addressing

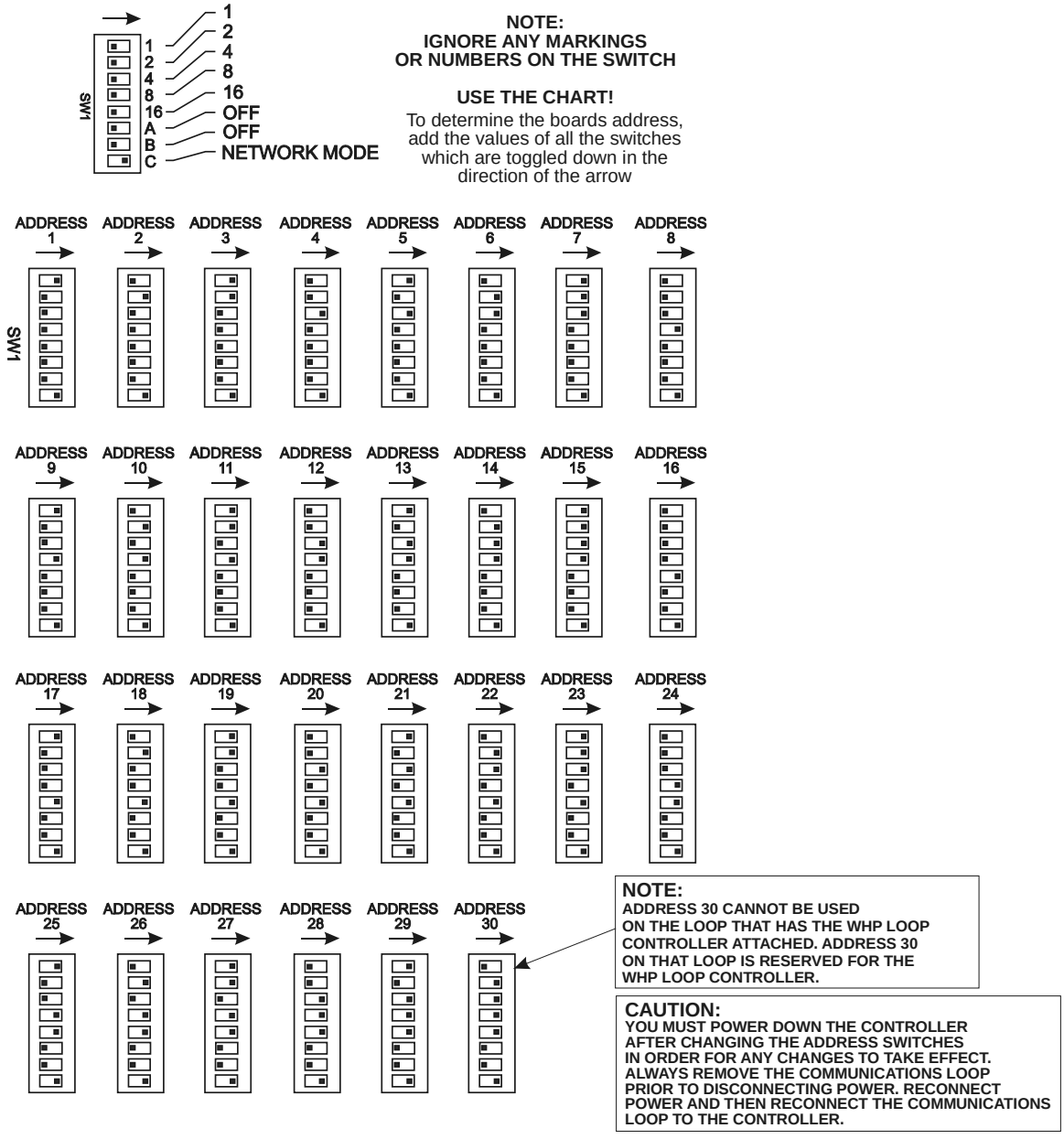


Figure 4-10: WHP Controller Address Switch Setting

5.0 Troubleshooting

5.1 General Troubleshooting

The following is a guide to assist in troubleshooting the WattMaster WHP System. It is provided as a systematic approach to determining and resolving common system problems.

5.1.1 Communications Troubleshooting Checklist

No WHP or Loop Controller Units are Communicating

- Is the CommLink II connected and plugged in?
- Is the CommLink II installed, a single or multiple loop version. A jumper in the CommLink can be set for "Single" or "Multi". On the WHP system is considered a Multiple Loop version and the CommLink jumper must be set on Multi.
- Are Comm Loop voltages correct? See the Comm Loop troubleshooting guides.(page 4-24)
- Is the Comm Loop open or shorted?
- Is the CommLink II connected and plugged in?
- Is the MiniLink Voltage correct?
- Are the WHP and Loop Controller address switches set correctly? See the addressing chart. (WHP Loop Controller should always be set to address 30, see **Figure 4-10**)
- Is the MiniLink address switch set correctly? See the addressing chart.(see **Figure 4-10**)
- Are the WHP and Loop Controllers powered? Check 24 VAC to the controllers.
- Is the System Manager connected to the Local Communications loop?

Some WHP Units are communicating but others are not:

- Are the WHP Controller address switches set correctly? See the addressing chart.
- Is the WHP Loop Controller address switch set correctly? See the addressing chart.
- Are the WHP Controllers and Loop Controller powered? Check 24 VAC to the controllers.
- Is the REC LED on the missing WHP Controller "flickering"? See WHP Controller introduction for location of the REC LED. (see **Figure 4-4**)
- Is the COMM LED on the WHP Controller blinking an error code? See the Blink Code chart. (see **Figure 4-6**)
- Are Comm Loop voltages correct at the missing unit? See Comm Loop troubleshooting guide starting on page 4-24.

5.1.2 General Troubleshooting Checklist

Begin troubleshooting by locating the general problem in the list below. Detailed component troubleshooting information follows later in this section.

Zone is too warm

- Is zone calling for cooling?
- Is the compressor disabled due to minimum off time setting?
- Is water proof of flow signal disabled?
- Is the LED blinking an error code? See **Figure 4-6**.

Zone is too cool

- Is zone calling for heating?
- Is the compressor disabled due to minimum off time setting?
- Is water proof of flow signal disabled?
- Is the LED blinking an error code? See **Figure 4-6**.

Zone Sensor reading incorrectly

- Is the sensor near a source of heat or a cold draft? Location is a common problem. The sensor should be mounted on an inside wall away from heat sources and in a location with adequate room air circulation.
- Is the resistance reading correct? Check with the **Temperature/Resistance Chart** in this section. (see page 4-42)
- Is wiring correct? Check for errors.

Check the Room sensor

- ***To meter the Room sensor:***
  Unplug the room sensor terminal block. Using your meter, check the resistance of the unplugged terminal block. Use the supplied **Temperature/Resistance Chart** (page 4-42) to see if the sensor is within a reasonable range. Readings which are much too high or too low generally indicate wiring problems.

- ***To meter the Slide Adjust (optional):***
  Use your ohmmeter to check the resistance between the room sensor **GND** wire and the **AIN2** terminal on the unplugged terminal block.

The resistance for various positions of the slider on the sensor should be as follows:

Full UP position	15K Ω (± 500 Ω)
MID position	12.5K Ω (± 500 Ω)
Full DN position	10K Ω (± 500 Ω)

5.2 Alarms

When an alarm occurs in the WHP or Loop Controller, it is reported to the System Manager. The alarms cause the light on the System Manager to illuminate. The View Alarms screen will indicate the address of the alarms. The Status screen will display the type of alarm that has occurred. Here is a list of the alarms that are reported to the System Manager.

WHP:

Bad Space Sensor – Space sensor is either open or shorted
Hi Space Temp Alarm – If space temperature is 5° or more above cooling setpoint
Lo Space Temp Alarm – If space temperature is 5° or more below heating setpoint
Dirty Filter Alarm – Contacts between AIN4 and GND are shorted
Cooling Failure – If supply air doesn't drop 5° in 10 minutes in cooling mode
Heating Failure - If supply air doesn't go up 5° in 10 minutes in heating mode

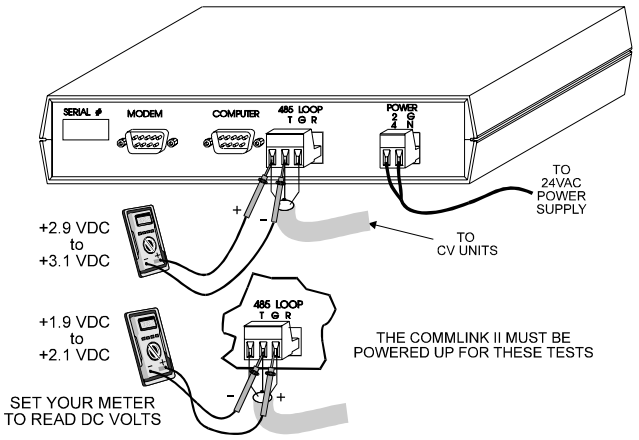
Loop Controller:

Pump Failure – No proof of flow within 5 seconds after pump starts
No Flow Detected – The contact between AIN3 and GND is open, no water flow
Phase Shutdown – The contact between AIN7 and GND is open, loss of phase
Lo Water Temp Alarm – Water Temp is below Lo Limit setpoint
Hi Water Temp Alarm - Water Temp is above Hi Limit setpoint

5.3 Checking Comm. Loop Voltages

5.3.1 Checking the CommLink II Network Loop

Diagram



Overview

This test checks for proper Network loop voltages at the CommLink II.

Tip: The Loop LED (located on the front panel) should "flicker" when the CommLink II is attempting to communicate. The Loop LED will flicker more noticeably for a few seconds when first powered up. If the Loop LED does not flicker, the unit is defective. Make sure CommLink II jumper is set to "Multi" position.

Proper loop voltages are essential for reliable communications. It is normal to see fluctuations at this point on the CommLink II. The average value should be close to the acceptable range described below. ***Values will vary upon initial powerup for about 10-15 seconds as the unit attempts to communicate.***

Measurements

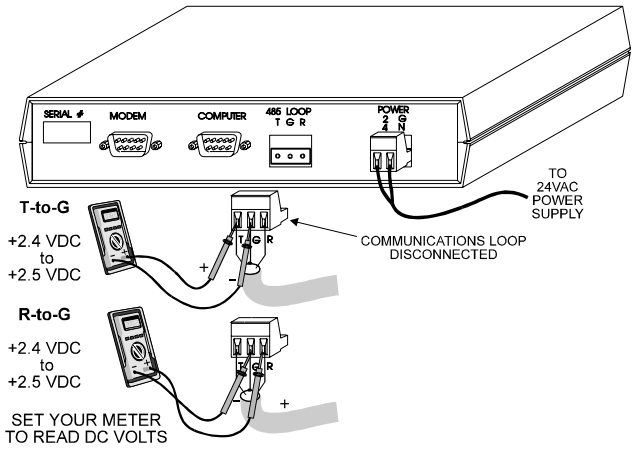
Network Loop	Acceptable Range
T - G (SHLD)	2.9 - 3.1 Volts DC
R - G (SHLD)	1.9 - 2.1 Volts DC

Action

Condition	Action
If voltages are too high or too low on either side	1. Unplug the Network loop from the CommLink II and check for proper loop voltages. If a problem exists, disconnect each MiniLink Network loop until the problem is isolated. 2. Check the CommLink II Driver chip. Replace the driver chip if necessary

5.3.2 Checking the Comm Loop at the CommLink II

Diagram



The indicated values are typical of a normal system, actual readings may deviate slightly due to the number of units connected and other system specific factors.

Note: All of the connected Minilinks should be powered up for this test.

Overview

This is a "quick check" to determine if any of the driver chips on the Network loop are damaged. Since all units will "float" both of their communications connections at about 2.45 Volts, you can quickly check the Network loop by unplugging it at the CommLink II.

Note: Be sure that the loop you are testing does not have a short circuit from T to R.

Tip: The Loop LED (located on the front panel) should "flicker" when the CommLink II is attempting to communicate with the MiniLinks. There is a noticeable change in the flicker when the loop is disconnected, if you observe a normal functioning unit. When the loop is reconnected it may take up to 60 seconds before the CommLink II re-establishes communications with the MiniLinks.

Measurements

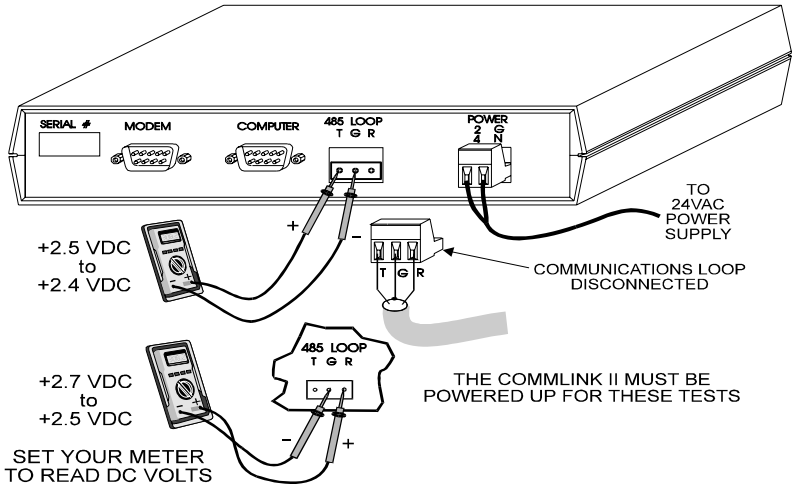
Network Loop	Acceptable Range
T – G (SHLD)	2.4-to-2.5 Volts DC
R – G (SHLD)	2.4-to-2.5 Volts DC

Action

Condition	Action
If voltages are too high or too low on either side	One or more of the MiniLinks has a damaged Network driver chip. Disconnect the Mini-Links one at a time to isolate the problem.

5.3.3 Checking the CommLink II Driver

Diagram



Overview

This test checks for proper Network loop voltages coming from the CommLink II.

Tip: The Loop LED (located on the front panel) should "flicker" when the CommLink II is attempting to communicate. The Loop LED will flicker more noticeably for a few seconds when first powered up. If the LED does not flicker, the unit is not functioning.

Proper loop voltages are essential for reliable communications. It is normal to see fluctuations at this point on the CommLink II. The average value should be close to the acceptable range described below. ***Values will vary upon initial powerup for about 10-15 seconds as the unit attempts to communicate.***

Measurements

Local Loop	Acceptable Range
T – G (SHLD)	2.4 - 2.5 Volts DC
R – G (SHLD)	2.5 - 2.7 Volts DC

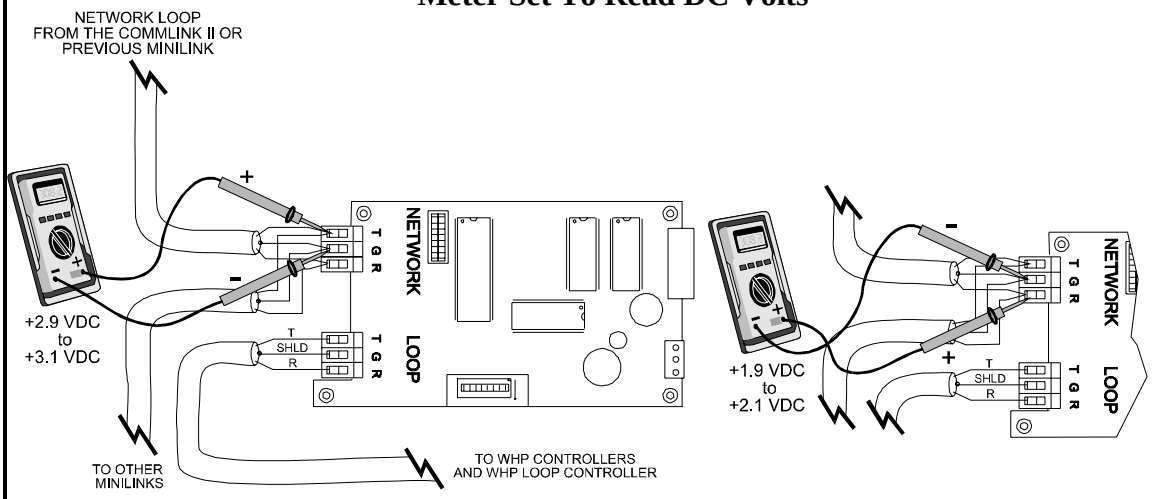
Action

Condition	Action
If voltages are too high or too low on either side	1. The CommLink II has a damaged comm driver chip. **Replace the driver chip.** *See instructions in section 1.3.11 for "Comm Driver Chip Replacement".* 2. The CommLink II is defective.

5.3.4 Checking the MiniLink Network Loop

Diagram

Meter Set To Read DC Volts



The indicated readings are typical of a ***normally*** operating system. Actual readings may vary slightly due to the number of units installed and other factors. Any significant deviation from these values generally indicates a problem.

Note: These tests assume that the CommLink II is connected and powered, and that all MiniLinks which are connected are also powered.

Overview

Proper loop voltages are essential for reliable communications. It is normal to see fluctuations on an operating communications loop. The ***average*** value should be close to the acceptable range described below. ***Values will vary upon initial powerup for about 15-30 seconds as normal communications occur***.

Measurements

LOCAL LOOP	Acceptable Range
T - G (SHLD)	2.9 - 3.1 Volts DC
R - G (SHLD)	1.9 - 2.1 Volts DC

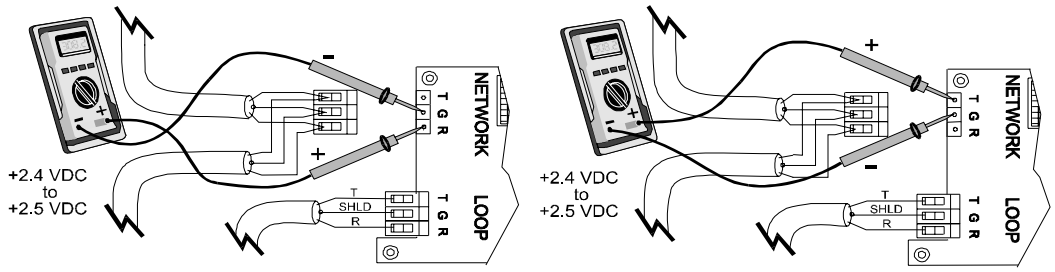
Action

Condition	Action
Readings near Zero Volts	Check for shorted wiring.
If voltages are too high or too low on either side	1. One or more devices connected to this loop may have damaged Comm driver chips. 2. Wiring errors. Check for multiple loops "cross connected", short circuits, etc.

5.3.5 Checking the MiniLink Network Driver

Diagram

Meter Set To Read DC Volts



Note: These tests assume that the MiniLink being checked is powered up

Overview

This check is intended to determine if the Network Comm Driver chip on a MiniLink is damaged.

Tip: Before unplugging the Network loop from the MiniLink, observe the Network Loop LED (located near the connector). It should periodically "flicker" as the CommLink II requests data from the MiniLink. The LED will also flicker when power to the CommLink II is cycled. If the LED is not flickering, the unit is not communicating with the CommLink II.

Damage typically occurs when the communications loop is exposed to excessive voltage, as may occur during installation due to wiring errors. The driver chips are socketed on all boards to facilitate servicing. It is unusual for driver chips to fail during normal operation. Almost all failures occur as a result of wiring related problems.

Measurements

Network Loop	Acceptable Range
T – SHLD	2.4 - 2.5 Volts DC
R – SHLD	2.4 - 2.5 Volts DC

Note: Minor variances may not indicate a problem if both tests indicate similar values

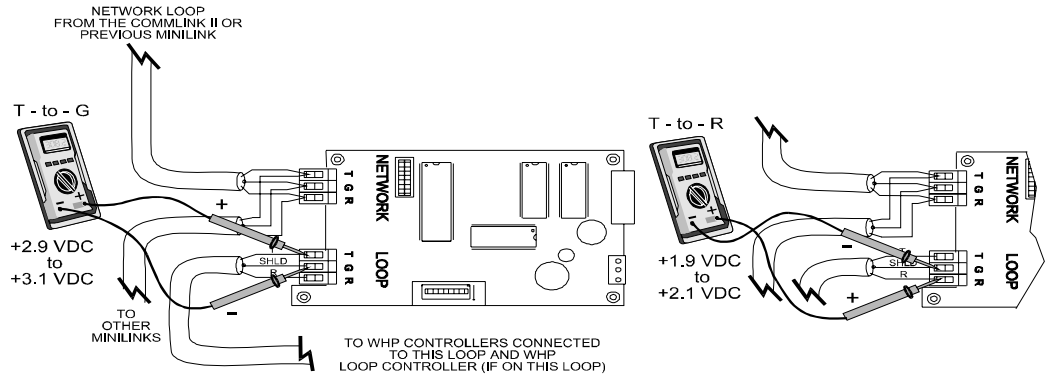
Action

Condition	Action
If voltages are too high or too low on either side	The MiniLink has a damaged Network Comm Driver chip. **Replace the driver chip.** *See "1.3.11Comm Driver Chip Replacement"*.

5.3.6 Checking the MiniLink Local Loop

Diagram

Meter Set To Read DC Volts



The indicated readings are typical of a normally operating system. Actual readings may vary slightly due to the number of units installed and other factors. Any significant deviation from these values generally indicates a problem.

Note: These tests assume the MiniLink is powered up

Overview

Proper loop voltages are essential for reliable communications. It is normal to see fluctuations on an operating communications loop. The ***average*** value should be close to the acceptable range described below. Values will vary upon initial powerup for about 30-45 seconds. ***Voltages fluctuate as normal communications occur.***

Measurements

Local Loop	Acceptable Range
T – SHLD	2.9 - 3.1 Volts DC
R – SHLD	1.9 - 2.1 Volts DC

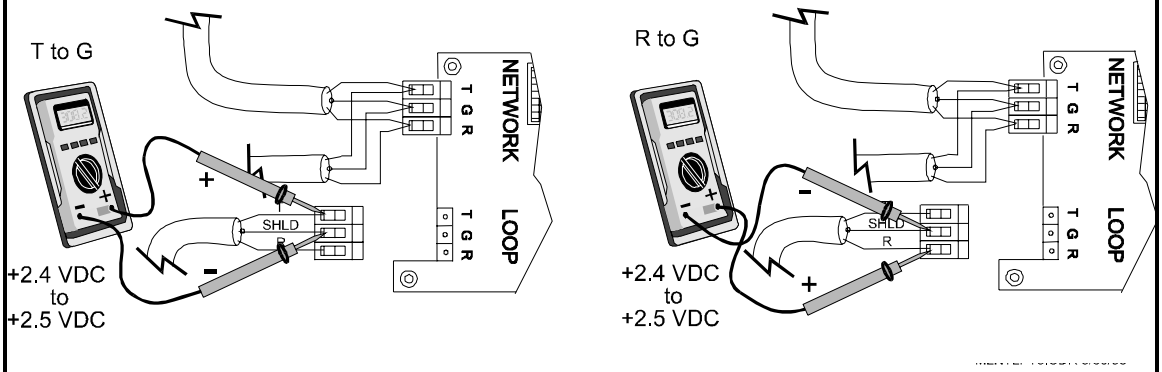
Action

Condition	Action
Readings near zero volts	Check for shorted wiring.
If voltages are too high or too low on either side	1. One or more devices connected to this loop may have damaged Comm Driver chips. 2. Wiring errors. Check for multiple loops inadvertently “cross connected”, short circuits, etc.

5.3.7 Checking the Local Loop at MiniLink

Diagram

Meter Set To Read DC Volts



The indicated values are typical of a normal system. Actual readings may deviate slightly due to the number of units connected and other system specific factors

Note: These tests assume that the controllers being checked are powered up.

Overview

This is a "quick check" to determine if any of the WHP Controllers or WHP Loop Controller on a Local Communications Loop are damaged. Since all WHP Controllers will "float" both of their communications connections at about 2.45 Volts, you can quickly check an entire loop by unplugging it at the MiniLink.

Note: Be sure that the loop you are testing does not have a short circuit from T - R.

Damage typically occurs when the communications loop is exposed to excessive voltage, as may occur during installation, due to wiring errors. The driver chips are socketed on all boards to facilitate servicing. It is unusual for driver chips to fail during normal operation. Almost all failures occur due to wiring related problems.

Measurements

Local Loop	Acceptable Range
T – SHLD	2.4 - 2.5 Volts DC
R – SHLD	2.4 - 2.5 Volts DC

Note: Minor variances may not indicate a problem if both tests indicate similar values.

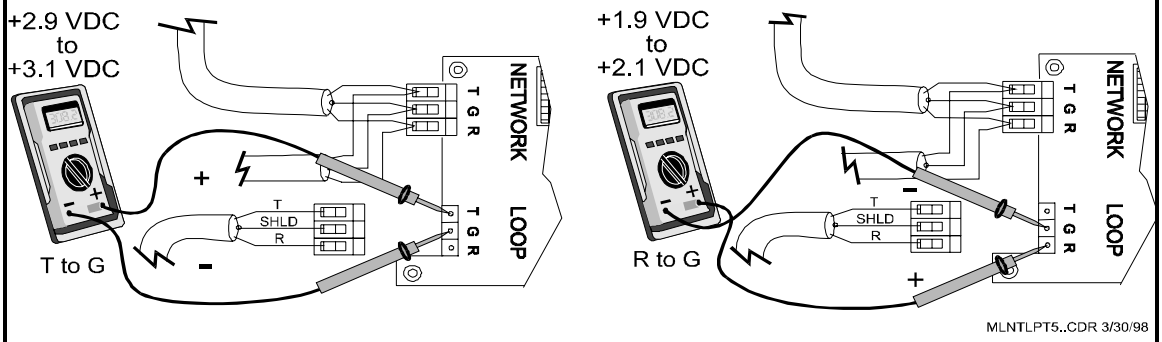
5.3.7 *(continued)*

Action	
Condition	**Action**
If voltages are too high or too low on either side	1. One or more of the attached controllers has a damaged Comm Driver chip. **Locate and replace the driver chip(s).** *See "1.3.11 Comm Driver Chip Replacement".* 2. Wiring errors such as "crossed connections", short circuits, etc.

5.3.8 Checking the MiniLink Local Loop Driver

Diagram

Meter Set To Read DC Volts



The indicated values are typical of a normal operating system. Actual readings may deviate slightly.

Note: These tests assume that the MiniLink is powered up.

Overview

This test checks for proper Local Loop voltages coming from the MiniLink.

Tip: The Local Loop LED (located near the connector) should "flicker" when the MiniLink is operating and when first powered up. If the LED is not flickering, the unit is not functioning.

Proper loop voltages are essential for reliable communications. It is normal to see fluctuations at this point on the MiniLink. The ***average*** value should be close to the acceptable range described below. Values will vary upon initial powerup for about 10-15 seconds. ***The voltage will fluctuate as the unit attempts to communicate.***

Measurements

Local Loop	Acceptable Range
T – G (SHLD)	2.9 - 3.1 Volts DC
R – G (SHLD)	1.9 - 2.1 Volts DC

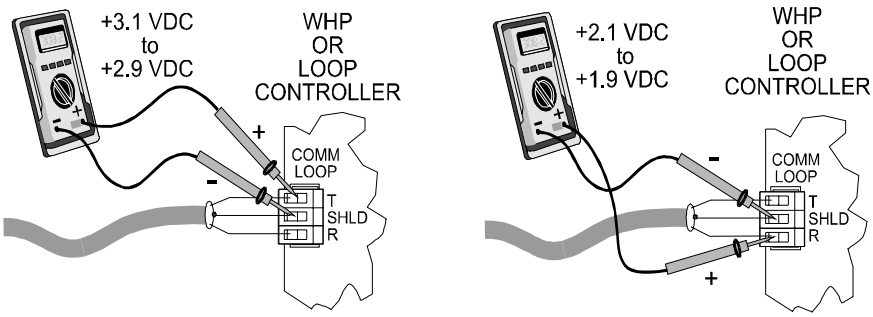
Action

Condition	Action
If voltages are too high or too low on either side	1. The MiniLink has a damaged Comm Driver chip. **Locate and replace the driver chip(s).** *See "1.3.11 Comm Driver Chip Replacement".* 2. The MiniLink is not functioning.

5.3.9 Checking the Local Loop at a WHP Controller

Diagram

Meter Set To Read DC Volts



The indicated readings are typical of a normal operating system. Actual readings may vary slightly due to the number of units installed and other factors. Any significant deviation from these values generally indicates a problem.

Note: These tests assume that a MiniLink is connected and powered up.

Overview

Proper loop voltages are essential for reliable communications. It is normal to see fluctuations on an operating communications loop. The ***average*** value should be close to the acceptable range described below. Values will vary upon initial powerup for about 30-45 seconds. ***The voltages may fluctuate as normal communications occur.***

Measurements

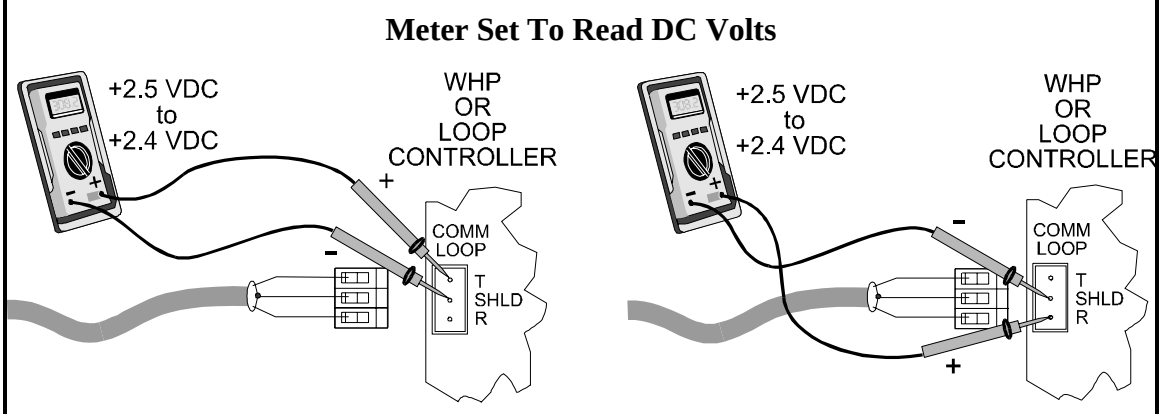
Local Loop	Acceptable Range
T – SHLD	2.9 - 3.1 Volts DC
R – SHLD	1.9 - 2.1 Volts DC

Action

Condition	Action
If meter reads between 2.4 VDC and 2.5 VDC The Comm Loop "floats" at 2.4 - 2.5VDC when *only* controllers are connected to the loop. When a MiniLink is connected it will "bias" each side of the loop to the values listed above.	1) No CommLink II or MiniLink is connected and powered up. 2) If a CommLink II or MiniLink is connected, look for "open" wiring.
If voltages are too high or too low on either side	One or more devices connected to this loop have damaged Comm Driver chips.

5.3.10 Checking WHP Controller Driver Chip

Diagram



Note: These tests assume that the controller being checked is powered up.

Overview

This check is intended to determine if the Comm Driver chip on a controller is damaged. Damage typically occurs when the communications loop is exposed to excessive voltage, as may occur during installation, due to wiring errors. The driver chips are socketed on all boards to facilitate servicing. It is unusual for driver chips to fail during normal operation. Almost all failures occur as a result of wiring related problems.

Measurements

Local Loop	Acceptable Range
T – SHLD	2.4 - 2.5 Volts DC
R – SHLD	2.4 - 2.5 Volts DC

Note: Minor variances may not indicate a problem if both tests indicate similar values.

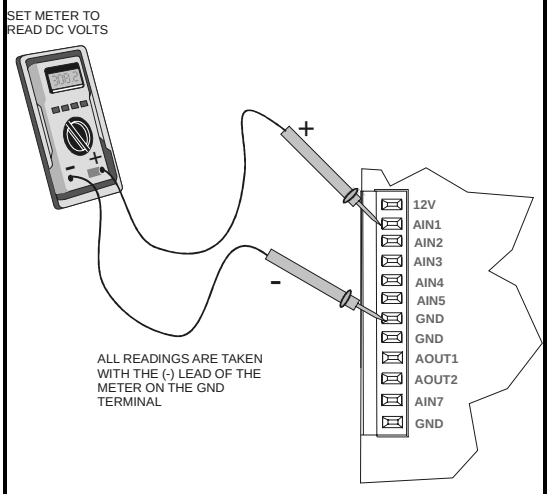
Action

Condition	Action
If voltages are too high or too low on either side	The controller has a damaged Comm Driver chip. **Replace the driver chip.** *See "1.3.11 Comm Driver Chip Replacement".*

5.4 Troubleshooting Loop Controller

5.4.1 Checking the Loop Controller Analog Inputs

Diagram



Overview

The analog input wiring can be checked at the Loop Controller by checking voltages on the Analog Input Connector.

If any of the RWT, SWT, OAT inputs read greater than 5.0 volts then it is OPEN (no sensor is connected), an input that reads less than 0.1 volts is SHORTED. Check for wiring problems before proceeding.

The Loop Pressure, Manual Reset, Phase Loss, Fire Alarm and Request to Run inputs should read greater than 5.0 volts if the attached contact is OPEN and less than 0.5 volts if the contact is CLOSED (contacts CLOSE between the input and GND). The Fire Alarm and Request to Run contacts are located on the Analog Input Expansion Board.

Note The Loop Controller must be powered for these tests.

Measurements

Meter	Acceptable Range
	Ignore readings for any connections which are not used in the equipment.
AIN1 Return Water Temp	1.9 volts (100°F) - 3.6 volts (40°F) Typical is 2.5 volts @ 77°F
AIN2 Supply Water Temp	1.9 volts (100°F) - 3.6 volts (40°F) Typical is 2.5 volts @ 77°F
AIN3 Proof of Flow	***When used with the Low Pressure Switch option:*** If the input is OPEN, the voltage will be greater than 5.0 volts If the input is CLOSED, the voltage will be less than 0.5 volts ***When used with 0-50 PSI Loop Pressure Sensor option:*** 5.1 VDC = 50 PSI – 0.0 VDC = 0 PSI

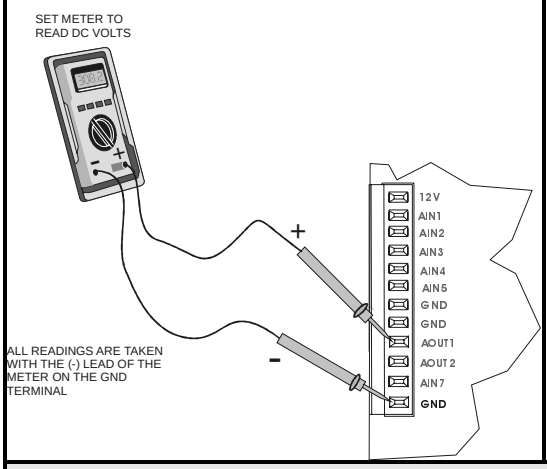
5.4.1 *(continued)*

AIN4 Outdoor Air Temp	1.9 volts (100°F) - 3.6 volts (40°F) Typical is 2.5 volts @ 77°F
AIN5 Manual Reset	If the input is OPEN, the voltage will be greater than 5.0 volts If the input is CLOSED, the voltage will be less than 0.5 volts
AIN7 Phase Loss	If the input is OPEN, the voltage will be greater than 5.0 volts If the input is CLOSED, the voltage will be less than 0.5 volts
AIN1-Exp. Bd. Fire Alarm	If the input is OPEN, the voltage will be greater than 5.0 volts If the input is CLOSED, the voltage will be less than 0.5 volts
AIN2-Exp. Bd. Request to Run	If the input is OPEN, the voltage will be greater than 5.0 volts If the input is CLOSED, the voltage will be less than 0.5 volts

Caution: **AIN1 – Fire/Smoke** input must be connected to the AIN1- GND terminal. If it is not used, a jumper must be installed, since this is a normally closed contact input. ***If this is not done the system will not operate.***

Condition	Action
SWT, RWT, OAT Input voltage reads too low	1. Check for shorts or other wiring errors. 2. Defective Sensor. Check using the chart. 3. High temperature at sensor. See chart.
SWT, RWT, OAT input voltage reads too high	1. Check for open circuit wiring errors. 2. Defective sensor. Check using the chart. 3. Low temperature at sensor. See chart.
LPR (when optional 0-5VDC Loop Pressure Sensor is used) input voltage reads too low.	1. Check for shorts or other wiring errors. 2. Defective Sensor. Check using the chart. 3. High pressure at sensor. See chart.
LPR (When Loop Pressure Switch is used) input voltage reads too high.	1. Check for open circuit wiring errors.

5.4.2 Checking the Loop Controller Outputs

Diagram	Overview
	The analog output wiring can be checked at the Loop Controller by checking voltages on the Analog Output Connector. **Note:** The Loop Controller must be powered for these tests.

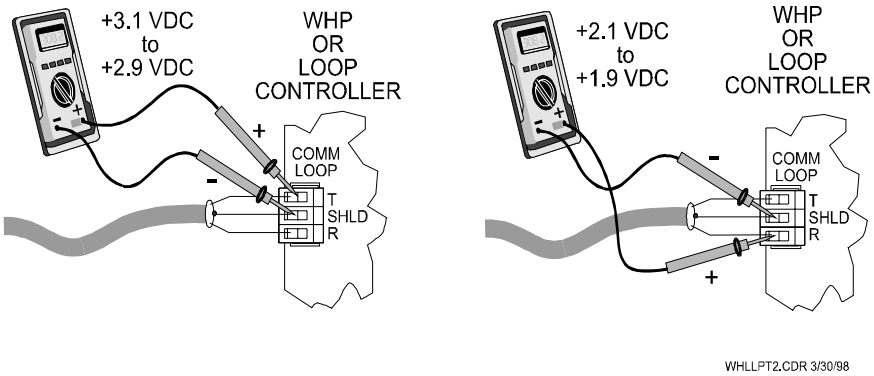
Measurements

Meter	Acceptable Range
	Ignore readings for any connections which are not used in the equipment.
AOUT1 Pump VFD	This output will vary between 0 and 10 VDC to correspond with pump pressure setpoint.
AOUT2 Mod. Heat	This output will vary between 0 and 10 VDC to correspond with Heat Addition setpoint.

5.4.3 Checking the Local Loop at a WHP Loop Controller

Diagram

Meter Set To Read DC Volts



The indicated readings are typical of a normal operating system. Actual readings may vary slightly due to the number of units installed and other factors. Any significant deviation from these values generally indicates a problem.

Note: These tests assume that a MiniLink is connected and powered up.

Overview

Proper loop voltages are essential for reliable communications. It is normal to see fluctuations on an operating communications loop. The ***average*** value should be close to the acceptable range described below. Values will vary upon initial powerup for about 30-45 seconds. ***The voltages may fluctuate as normal communications occur.***

Measurements

Local Loop	Acceptable Range
T – SHLD	2.9 - 3.1 Volts DC
R – SHLD	1.9 - 2.1 Volts DC

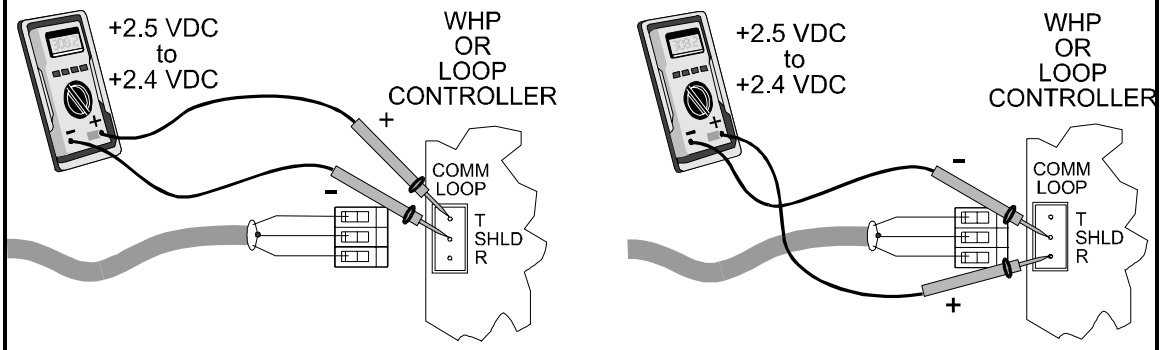
Action

Condition	Action
If meter reads between 2.4 VDC and 2.5 VDC The Comm Loop "floats" at 2.4 - 2.5VDC when *only* controllers are connected to the loop. When a MiniLink is connected it will "bias" each side of the loop to the values listed above.	1) No CommLink II or MiniLink is connected and powered up. 2) If a CommLink II or MiniLink is connected, look for "open" wiring.
If voltages are too high or too low on either side	One or more devices connected to this loop have damaged Comm Driver chips.

5.4.4 Checking WHP Loop Controller Driver Chip

Diagram

Meter Set To Read DC Volts



Note: These tests assume that the controller being checked is powered up.

Overview

This check is intended to determine if the Comm Driver chip on a controller is damaged. Damage typically occurs when the communications loop is exposed to excessive voltage, as may occur during installation, due to wiring errors. The driver chips are socketed on all boards to facilitate servicing. It is unusual for driver chips to fail during normal operation. Almost all failures occur as a result of wiring related problems.

Measurements

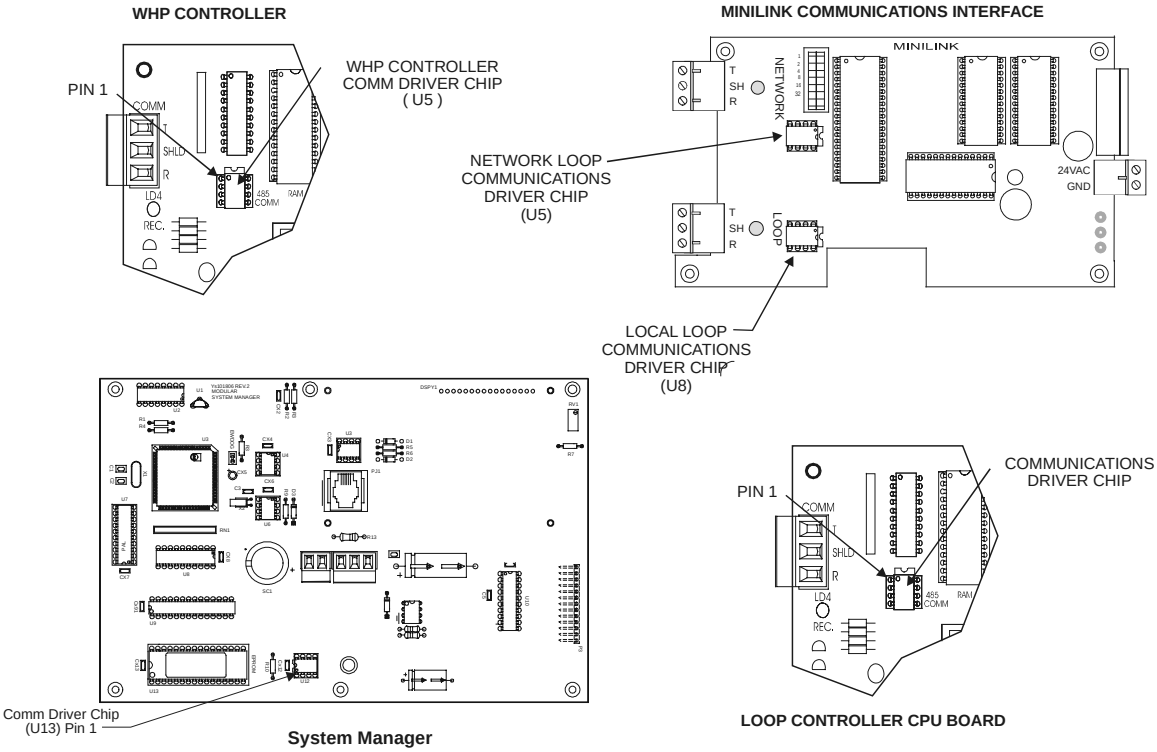
Local Loop	Acceptable Range
T – SHLD	2.4 - 2.5 Volts DC
R – SHLD	2.4 - 2.5 Volts DC

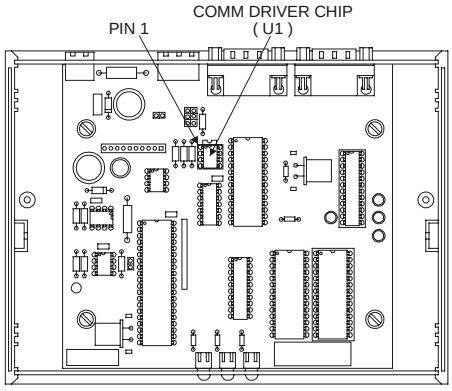
Note: Minor variances may not indicate a problem if both tests indicate similar values.

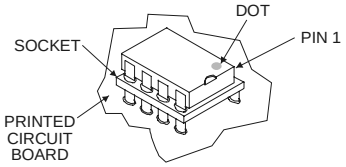
Action

Condition	Action
If voltages are too high or too low on either side	The controller has a damaged Comm Driver chip. **Replace the driver chip.** *See "1.3.11Comm Driver Chip Replacement".*

5.4.5 Comm Driver Chip Replacement







WARNING!

USE EXTREME CAUTION WHEN REMOVING ANY CHIPS TO AVOID DAMAGING ANY CIRCUIT BOARD TRACES WHICH ARE UNDER THE CHIP.

BE SURE THAT ANY SMALL SCREWDRIVER OR OTHER SHARP OBJECT USED TO REMOVE THE CHIP DOES NOT COME INTO CONTACT WITH THE PRINTED CIRCUIT BOARD SURFACE.

A SMALL SCREWDRIVER MAY BE INSERTED BETWEEN THE CHIP AND THE SOCKET TO AID IN REMOVAL OF THE CHIP.

BE VERY CAREFUL NOT TO INSERT THE SCREWDRIVER UNDER THE SOCKET!! DAMAGE TO THE BOARD IS NOT COVERED BY WARRANTY.

Figure 4-11: Comm Driver Chip Replacement

5.5 Temperature Sensor Resistance Chart

TEMPERATURE °F	RESISTANCE Ω*	VOLTAGE AT INPUT*
-10	93333	4.620
-5	80531	4.550
0	69822	4.474
5	60552	4.390
10	52500	4.297
15	45902	4.200
20	40147	4.095
25	35165	3.982
30	30805	3.862
35	27140	3.737
40	23874	3.605
45	21094	3.470
50	18655	3.330
52	17799	3.275
54	16956	3.217
56	16164	3.160
58	15385	3.100
60	14681	3.042
62	14014	2.985
64	13382	2.927
66	12758	2.867
68	12191	2.810
69	11906	2.780
70	11652	2.752
71	11379	2.722
72	11136	2.695
73	10878	2.665
74	10625	2.635
75	10398	2.607
76	10158	2.577
78	9711	2.520
80	9302	2.465

TEMPERATURE °F	RESISTANCE Ω*	VOLTAGE AT INPUT*
82	8893	2.407
84	8514	2.352
86	8153	2.297
88	7805	2.242
90	7472	2.187
95	6716	2.055
100	6047	1.927
105	5453	1.805
110	4923	1.687
115	4449	1.575
120	4030	1.469
125	3656	1.369
130	3317	1.274
135	3015	1.185
140	2743	1.101
145	2502	1.024
150	2288	0.952

*Notes:

1. Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

2. Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-"(minus) lead on GND terminal and the "+"(plus) lead on the sensor input terminal being investigated.

   If the voltage is above 5.08 VDC, then the sensor or wiring is "open." If the voltage is less than 0.05 VDC, the sensor or wiring is shorted.

5.6 Pressure Sensor Voltage Chart

PRESSURE PSI	CURRENT MILIAMPS	VOLTAGE AT INPUT VDC*
0	4.00	1.00
1	4.32	1.08
2	4.64	1.16
3	4.96	1.24
4	5.28	1.32
5	5.60	1.40
6	5.92	1.48
7	6.24	1.56
8	6.56	1.64
9	6.88	1.72
10	7.20	1.80
11	7.52	1.88
12	7.84	1.96
13	8.16	2.04
14	8.48	2.12
15	8.80	2.20
16	9.12	2.28
17	9.44	2.36
18	9.76	2.44
19	10.08	2.52
20	10.40	2.60
21	10.72	2.68
22	11.04	2.76
23	11.36	2.84
24	11.68	2.92
25	12.00	3.00
26	12.32	3.08
27	12.64	3.16
28	12.96	3.24
29	13.28	3.32
30	13.60	3.40
31	13.92	3.48
32	14.24	3.56
33	14.56	3.64
34	14.88	3.72
35	15.20	3.80
36	15.52	3.88
37	15.84	3.96
38	16.16	4.04
39	16.48	4.12
40	16.80	4.20
41	17.12	4.28
42	17.44	4.36
43	17.76	4.44
44	18.08	4.52
45	18.40	4.60
46	18.72	4.68
47	19.04	4.76
48	19.36	4.84
49	19.78	4.92
50	20.00	5.00

***Notes:**

1. Use the voltage column to compare the meter voltage with the sensor connected to the controller and with the controller powered.

2. Read voltage with meter set on DC volts. Place the "-"(minus) lead on GND terminal and the "+"(plus) lead on the sensor input terminal being investigated.

3. If the voltage is less than 0.05 VDC, then the sensor or wiring is "shorted" or "open"

Notes:

WattMaster CONTROLS

Form: WM-WHP-IO-02A Printed in the USA October 2004
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Wattmaster Controls Inc. • 8500 NW River Park Drive • Parkville MO • 64152
Phone (816) 505-1100 E-mail: mail@wattmaster.com Fax (816) 505-1101